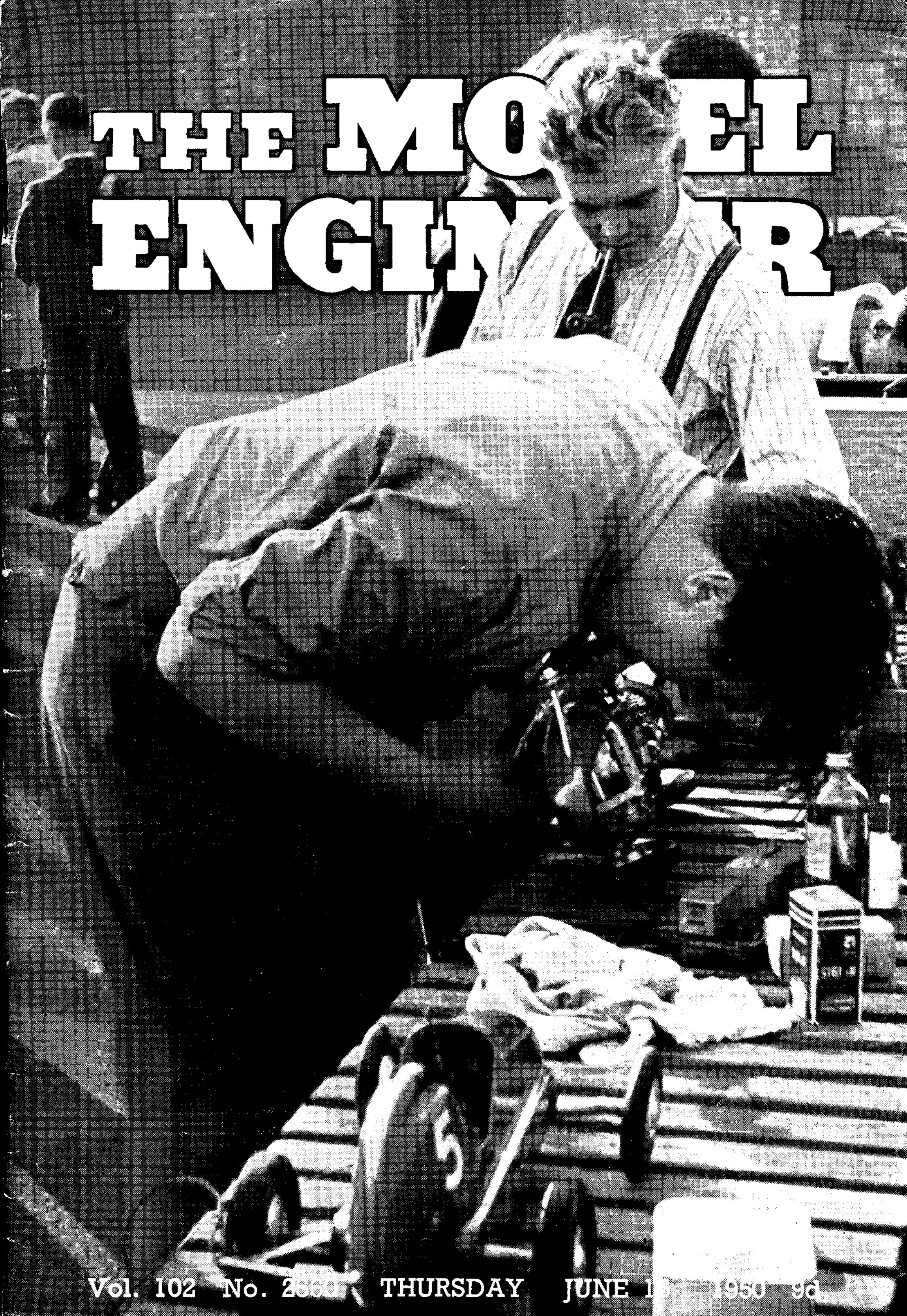

THE MODEL ENGINEER

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The MODEL ENGINEER

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15TH JUNE 1950 VOL. 102 NO. 2560

SMOKE RINGS

Our Cover Picture

● MESSRS. GARROD (nearest the camera) and Flower, both well known in miniature motor racing circles, in the "pits" on the occasion of an exhibition meeting at the G.E.C. model racing car club. Note the car in the foreground, of American origin, the spare tyres, two different types of fuel container and the assortment of tools and other equipment, all so essential to the running of these very fascinating models.

Mr. Garrod is carrying out an adjustment prior to some very rapid gyration.

Enthusiasm Does It

● IN ONE of his recent letters to us, Mr. Frank Roberts, of Auckland, New Zealand, ends on a somewhat plaintive note; he writes: "What lovely stuff is advertised in your journal! If we could only get hold of some of it over here! Luckily, my workshop is now fully equipped. Fancy being able to say that, at last! I made all the equipment myself, and can now do milling, gear-cutting, etc.; I have a flexible drill, grinder and, latest, an acetylene Prestolite (I have been waiting for this for about 6 years). Should be happy now, eh?"

He certainly should; but think of the philosophical outlook of a man, now close on 70 years of age, who undertook to make all the equipment in his workshop so that he could get on with his model making, in spite of all the handicaps and difficulties involved. There are many of our readers who complain of the difficulties and consequent frustration against which we are ever battling here, at the present time; but, as always, there are other people who are in worse plight. Mr. Roberts's comments show this plainly, and he is not the only one of our Dominions readers who has written in similar strain. Moreover, as we hope to show our readers, in due course, he is a model maker of no mean order; as a retired engineman, his main interest is in the steam locomotive, and he has sent us some photographs of his work in making, literally, portraits in the solid of some of his favourites. We think they are really good and we shall be pleased to publicise them in our pages, as soon as space is available.

Another "M.E." Exhibition Prize

● MR. V. B. FERGUSON, of Cheltenham, has very kindly donated £2 2s. to be awarded for the best stationary model steam engine of any type. The prize will be awarded, of course, at the discretion of the judges. We are glad to note this offer, which should help to maintain interest in the stationary engine.

The "M.E." and Maritime Interest

● WE HAVE had criticisms about the lack of maritime material in THE MODEL ENGINEER; the obvious answer is that it is now in *Model Ships and Power Boats*. We recently met some readers of THE MODEL ENGINEER who did not even know that there was such a magazine as *Model Ships and Power Boats*. This shows how unobservant one can be in reading only certain parts of the magazine. We announced the new magazine when it was first published in January, 1948, and have advertised it at intervals ever since. Although there is no lack of maritime material of a kind, there is a real dearth of constructional articles on making hulls and parts for model steamships or warships. *Model Ships and Power Boats* has only limited space and ship modelling covers a very wide field; so from time to time, we could put articles on maritime subjects of more particular interest to the model engineer in the parent paper, if we can get them. Readers are only too pleased to send photographs of their models when finished, and to tell us of their successes in sailing and exhibiting them, but very few can take their minds back to the beginning and describe step by step how they made them. This is the type of article which helps our readers, especially the beginner. In the old days, THE MODEL ENGINEER used to contain a considerable maritime interest, and has even had articles and descriptions of model yachts and historical ships. These are somewhat removed from model engineering and are naturally more at home in a maritime magazine; but power units and hydroplanes are 90 per cent. engineering and could well be in THE MODEL ENGINEER. The construction of a model hull is probably 50 per cent. shipbuilding and 50 per cent. engineering, and could be in either paper. The circulation of THE MODEL ENGINEER is much greater than that of *Model Ships and Power Boats*, but against that, the whole of the readers of the smaller magazine have an interest in ships, whereas probably only a small proportion of THE MODEL ENGINEER readers have. We would value the comments of our readers on this matter, and still more would we appreciate it if readers who are interested in the building of model ships would send us their articles, especially if on the lines we have indicated.

More About That Ship Model

● OUR COMMENTS under the heading "Where Some Model Makers Fail" have brought in a number of letters, most of which agree with our views that when anyone sets out to build a model of anything at all, no matter if the model is either a copy of some existing prototype or an entirely free-lance design, he should be quite sure that he is fully aware of the fundamental details of full-size practice.

But one or two readers suggest that, for some reason best known to ourselves, we wrote our comments with the deliberate intention of condemning a very fine piece of work! Nothing was farther from our thoughts; the only sensation which inspired our pen was that of disappointment because such a splendid piece of work is spoiled by so many faults. And we did not exhaust the list of faults, but mentioned some which any knowledgable ship-lover could confirm from the illustration. Here are a few more—some of them fairly obvious: The rails around the fo'c'sle head should be vertical; the masts are too tall, and the hoist of the upper sails is too high; the bowsprit is set up at too great an angle; for the period represented by the model, the wire rigging should be shown with bottle-screws for the shrouds, not with deadeyes and lanyards; the blocks are too big, and the sails should be clewed up to the bunt and not to the yardarms. Naturally, the majority of these errors are more readily discernible in the original photograph than they are in the reproduction; but the fact that they are there at all can arouse nothing but irritation and disappointment in the mind of the ship-lover who *knows* his ships, even if they were never built!

And so it can be with models of most kinds, more especially with those which claim to represent some prototype. It is due to a lack of appreciation of details, and is to be deprecated. The rawest novice producing the crudest model can easily see to it that his details are fundamentally correct, even if his knowledge, skill and equipment do not permit him to get the dimensions exactly to scale. Faulty dimensions are often excusable, but errors of detail, especially when they clearly reveal a lack of care in acquiring information, are not. We are aware that modern art seems to permit the greatest extravagances in the distortion of line, form, colour and detail; but these things should never be allowed to encroach upon our hobby of model making or to contaminate the craftsmanship which our efforts would strive to preserve. A true model should represent its prototype accurately; and that demands more than a modicum of the craftsmanship which was put into the prototype.

The F.P.A. Journal

● WE HAVE been favoured with a copy of the *F.P.A. Journal*, No. 9. This is a quarterly publication of the Fire Protection Association, and we need scarcely remark that it deals exclusively with a very serious subject. The most important contribution to this particular issue is, perhaps, the article on *The Fire Retardant Treatment of Textiles and Timber* by S. H. Clarke, M.Sc., who discusses this most important topic, points out what can be done and reaches the conclusion that once a fire is fully developed, such treatment can have only little influence on its course.

There are accounts of notable fires and their probable causes, an interesting and informative article on *The Machining of Magnesium Alloys* — an operation which involves a very considerable risk of fire—and there are some useful technical notes as well as a comparative table of fire for the last five years.

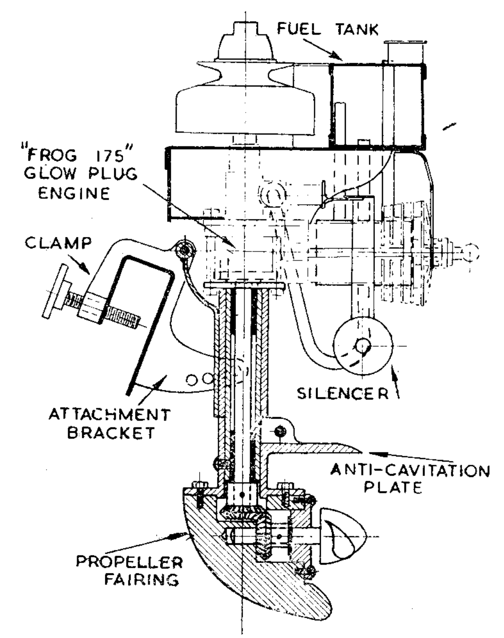
But whatever the contents of this nicely-produced, 32-page journal may be, they are obviously intended to serve as potent and essential propaganda to emphasise the necessity for educating all classes of the community in how to avoid the risks of fire. The journal is issued to members of the F.P.A., and further information can be obtained from 84, Queen Street, London, E.C.4.

PETROL ENGINE TOPICS

Why not a Model "Outboard"?

by Edgar T. Westbury

ONE of the most interesting developments in small marine power plants during the present century, is the outboard motor unit, which has been the means of converting hundreds of thousands of rowing boats to mechanical propulsion, has provided auxiliary power for small sailing craft, and has created an entirely new cult in aquatic sport. In this type of motor, more than any other, the possibilities of small-capacity high-performance engines have been demonstrated in no uncertain manner, and engines as small as 30 c.c. have proved capable of standing up to heavy everyday tasks. The outboard motor has served as the test bed for many important developments in the design of two-stroke engines, including the rotary admission valve, and the flywheel magneto, which have attained their highest popularity in this particular application.



Sectional view of transmission system of model outboard unit

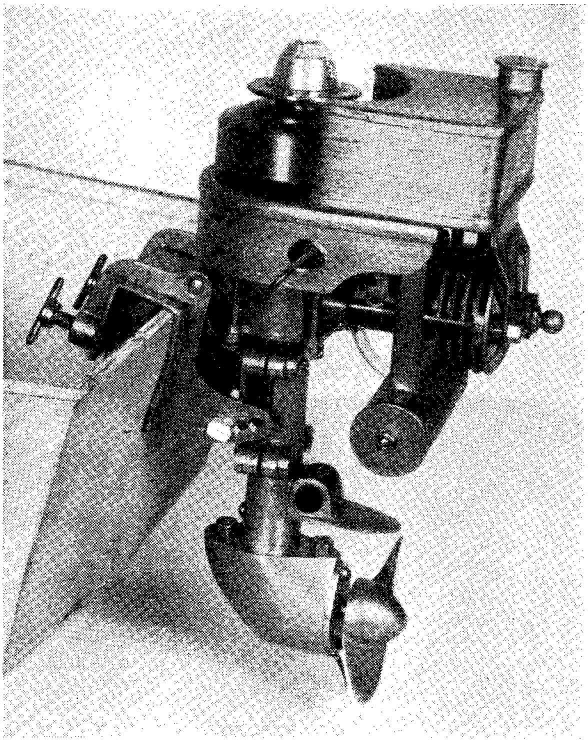
The beginnings of the outboard motor were humble, and strictly utilitarian ; it started with the simple and obvious idea that it would be handy to have some means of saving the labour of rowing a small boat by hooking on a mechanical power unit to do the work. In putting this into practice, the early engines were cheap, crude and relatively inefficient, but their practical success was so marked that they were in great demand among all users of small water craft. Although there have been many rivals to the simple two-stroke, with one or more cylinders, for this class of work, including steam engines and electric motors, it has, generally speaking, reigned supreme not only for honest slogging utility work, but also for high-performance sporting purposes.

The outboard unit is a typical example of a device which has so far outgrown its original *raison d'etre* that in some of its modern applications it has asserted a predominance over the object it was designed to serve. That is to say, whereas the entire aim and intention of the early outboard engine was to make it capable of quick and easy application to a boat of practically any type, shape or size, it is now common to find boats specially designed to suit the outboard engine and unsuitable for any other purpose. This is particularly true in the case of racing hydroplanes, where the weight distribution has a very pronounced influence on full design, and when outboard motors are used for this purpose, the plant weight is concentrated entirely at the extreme stern end of the hull, so the rear lifting planes have to carry most of the weight, instead of the more even distribution of weight on front and rear planes which is possible with inboard engines. So far from being a disadvantage, however, this difference can, under circumstances, be utilised as an asset, and proof of this is found in the success of small outboard racing craft. In some cases, however, powerful outboard engines, instead of being mounted on the stern of the boat, are installed in a well cut into the floor of the hull at some point further forward, so that the humble outboard steps out out of its class by becoming very definitely an "inboard" motor! It still, however, retains its basic characteristics of being a completely self-contained and detachable marine propulsion unit.

Modern outboard engines are made with one, two and four cylinders, and in a wide variety of sizes, developing up to over 20 h.p. Most of them nowadays have the power head, almost, or completely enclosed by sleek streamlined casings, which no doubt adds glamour, but detracts from their interest from the mechanical aspect.

Modelling the "Outboard"

Despite the popularity of the outboard motor in full-size practice, it has received very little attention at the hands of model engineers up to the present. In the passionate quest for high efficiency, model engineers often pass by, with hardly a glance, any aspect of en ginedesign which does not appear to further this single-track line of progress. But as I have pointed out many times, the byways of design are just as interesting from the purely model engineering aspect as the broad highways, and much may be lost by neglecting them. The idea that progress consists of nothing more than squeezing more revs. and power out of a small engine is very prevalent at the present day, but it is a very short-sighted policy, and one that is likely to defeat its own purpose in the long run, because it engenders a form of design which neglects everything except the obvious. If one can conceivably apply lessons learned in full-size practice, the outboard motor is by no means to be despised as a means of producing high performance per engine capacity, and its application to marine propulsion certainly cannot be regarded as inefficient.



Port side of unit, showing fuel regulating needle, double attachment clamp and silencer

Nevertheless, very few attempts to model the outboard engine have been recorded so far, though imitations of it in the form of small electric motors have attained a certain measure of popularity. Some years ago, Mr. Blaney of the Victoria M.S.C., built a model steamboat with an oscillating engine mounted on the transom of the hull in the traditional outboard fashion, but this could hardly be regarded as a true self-contained outboard unit, even if one discounts the idfference in the form of power applied. Mr. J. Latta constructed a very interesting 47-c.c. outboard unit which was described under "Petrol Engine Topics" during the war, but this was quite a powerful unit intended to propel a full-size boat, and not a model as commonly understood; it was, however, of interest to readers of THE MODEL ENGINEER as a subject within the capacity of the home workshop and the scope of the model engineer's ability.

Several years ago, I designed a 30-c.c. gearless outboard engine, which I hoped to get into commercial production; this also was intended to propel a full-sized boat. The idea was at the time regarded as impracticable, though the identical mechanical principles were later adopted in a successful American outboard unit. I have often contemplated getting down to a design for a small model outboard unit which could be applied to craft of the popular size as run in model power boat competitions, but have been very dubious about its reception by readers, and few of the fraternity with whom the project has been discussed have expressed much faith in its future. But in the course of recent correspondence with Mr. G. O. Caird, of the Bromley M.P.B.C., I discovered at least one red-hot enthusiast who has made a very definite practical contribution to the cult of the model outboard, and has also suggested that an outboard class of model racing boats would create a new attraction to the ranks of model power boat enthusiasts. When this suggestion was first voiced at a meeting of his local club the inevitable reply was "O.K.—you build the first engine!", which Mr. Caird promptly proceeded to do.

The unit, illustrated herewith, is built around the basis of a Frog "175" glow-plug engine, and as will be seen, is by no means an uncharacteristic representation of the full-sized unit, though naturally differing in points of detail. Although most outboard engines are water-cooled, the use of an air-cooled engine is not entirely out of place, and in any case could be excused on the grounds of practical expediency. As regards the parts which have been altered or added to the engine, these are truly in keeping with outboard practice and give an authentic air of realism to the ensemble.

The alterations to the engine as originally constructed consist mainly of the fitting of a new rear endplate to the crankcase, which in place of the fuel reservoir, embodies the extension shaft housing and bushes; also the fitting of a special flywheel and starting pulley, and a sheet metal exhaust belt around the cylinder, to lead

the gases into a cylindrical silencer fitted crosswise underneath. A sheet metal cowling is fitted above the engine cylinder and around the main bearing housing, and forms a platform for the fuel tank, which is shaped to fit partially around the flywheel, in conformity with traditional outboard practice.

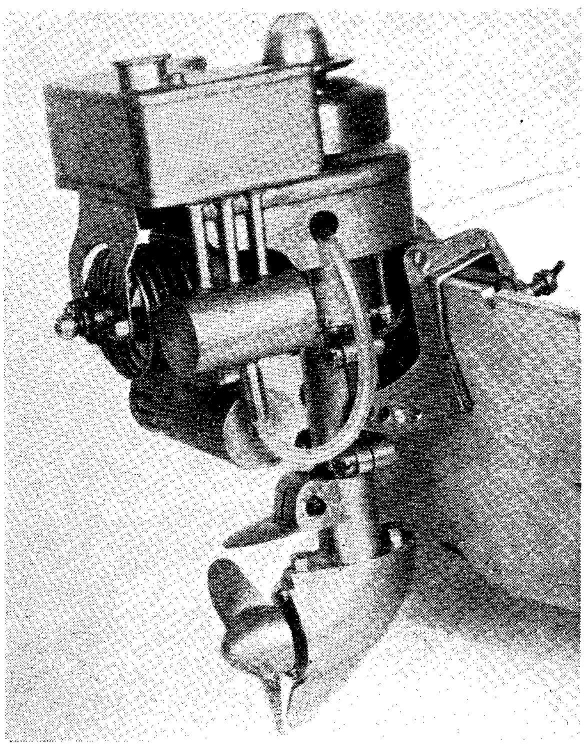
As the Frog engine is fitted with a rotary admission valve in the crankshaft, the carburettor is inside the cowling, the fuel adjustment screw passing through the side, and a choke of the "clarinet-stop" type is fitted to assist starting. In order to prevent flooding, the feed is not taken direct by gravity from the main tank, but an ingeniously-arranged "bird-feed" system is provided; this embodies a small cylindrical tank about $\frac{1}{2}$ in. below the jet level, which is not visible in the drawing, but can be seen in the photograph of the starboard side view.

The drive is taken from the crankpin of the engine, through a follower disc to the extension shaft, which has a bevel gear at its lower end, to drive a similar gear on the propeller shaft at a ratio of 1 : 1. A streamlined casing encloses the gearing, and a two-bladed propeller $1\frac{1}{2}$ in. diameter by 2 in. pitch is fitted.

As the extension shaft is in one piece, the usual telescopic adjustment for adapting the unit to varying height of transom, or depth of propeller immersion, is lacking, though it could easily be added if required. Another respect in which the model is simplified is by the omission of the tiller control for steering by swinging the entire unit, but this is unnecessary, and even undesirable in a model boat which is required to navigate without the aid of a pilot. The steering may, however, be set either for straight or circular course running by slackening the split clamp of the lower housing and swivelling the unit as required. As in full-size practice, the attachment of the unit to the hull is by means of a double hand clamp bracket with a pivotal connection at the top to an extension of the split clamp on the shaft housing, and a quadrant at the base of the bracket is provided with a stop bolt to adjust the angle of thrust, while allowing the unit to tilt backwards in the event of the propeller bearing housing meeting an obstruction.

The horizontal fin over the propeller bracket is provided for stabilising the flow of water over the propeller and is usually termed an "anti-cavitation plate," though it may be open to question whether it really performs this function. It is provided with a clamp screw by means of which the flange forming the top of the gear casing is held on the lower end of the extension shaft housing, and gives some facility for vertical movement of the assembly to adjust the meshing of the bevel gears, prior to positive location by a screw in the forward side of the clamp sleeve and extension housing. The entire unit is approximately 6 in. high and weighs 12 oz. all on. It is to be fitted to a 16 in. planked model of a pram dinghy, which will be used as a "guinea pig" for tests and experiments with a view to the design of an entirely new unit, including the engine, and its application to a faster type of hull.

Mr. Caird suggests that, if and when, the outboard is given a competition class of its own, the engine capacity should be limited to $2\frac{1}{2}$ c.c., with which I entirely agree, as I consider that this form of power unit is liable to become rather unwieldy if made in a larger size, and the capabilities of small, light craft with tiny engines are by now firmly established. It is quite practicable to run straight course races for light boats up to about 15 m.p.h. and Mr. Caird's suggestion that these boats might emulate the acrobatics of their full-size counterparts by running over a ramp and doing long jumps would certainly be an alternative attraction to that of sheer speed, which is the only present incentive to the model hydroplane enthusiast. I can see regatta organisers holding up their hands in horror at the idea of introducing yet another competition class, but though this adds yet another burden to their already overloaded backs, it is necessary to keep in mind the necessity to cope with ever-broadening outlook in design and interests. One advantage of the outboard unit is that it can very readily be changed over from one hull to the other, and it is by no means



Starboard side view of Mr. Caird's 1.75 c.c. outboard unit, showing "bird-feed" fuel supply system

beyond the bounds of possibility that a single engine may be used with success in both speed and steering competitions. I shall be very interested to learn what readers think of the prospects for the model outboard, and shall be glad to assist in the development of its design if it appears to stand a chance of becoming popular.

Land Outboards !

A very significant development in the application of small petrol engines at the present day is the motor-assisted bicycle (as distinct from the low-powered auto-cycle, designed and built as such). Not only has the commercial development of small engines designed for attachment to ordinary bicycles proceeded apace, particularly on the Continent, and also to a substantial extent in this country, but the fact that engines of suitable size can be built with model workshop equipment has encouraged many amateur constructors to embark on schemes of this nature. Some two years ago, Mr. Ostler of the Ipswich S.M.E. described an engine attachment of this kind in THE MODEL ENGINEER, and on visiting the Ipswich Society's Exhibition this year I was very interested to see a further example of his work and also a new power unit by another member of the same society.

Castings and parts for power units of this type are available from several sources, the latest which has come to my notice being one introduced by Messrs. F. Atkinson, 14, Aldwarke Road, Parkgate, near Rotherham, Yorks. This differs from the usual type of attachment which is mounted either over the front or rear wheel, being designed to fit in the frame, on the principles favoured by the orthodox type of motorcycle, and to drive the rear wheel by means of a chain. It also embodies a chain-driven countershaft, which serves as a first-stage reduction shaft, and is also equipped with a friction clutch of the orthodox motor-cycle type. I have examined the blueprints of this design and also sample castings of the cylinder and liner, and from what I can see of them it should be possible for the amateur to construct quite a successful cycle power unit from them with the usual home workshop equipment. It is, however, necessary for me to point out that I have not tried out either this or any other of the designs recommended for amateur construction, and cannot therefore endorse their merits from practical experience.

I have, however, had some experience with the use of very small " auxiliary " engines for road traction, dating back much further than the present trend of fashion in these units, having used a 50 c.c. two-stroke to propel a four-wheeled passenger vehicle over 20 years ago. I have also done a good deal of development work on one of the units which is now in commercial production. On the strength of this experience, I would like to issue a note of warning to those would-be designers and constructors (and this applies not only to amateurs) who think that driving a bicycle with a tiny engine is as easy as falling off a log. Propositions of this nature always seem to attract enthusiastic promoters who do not appreciate the problems involved, or think that they know much better than the old and cautious motor cycle designers who insist on the use of larger engines.

An engine of 50 c.c. or less must necessarily be really good to drive a bicycle with an average-size person on board, and to keep on doing it for 365 days in a year without developing mechanical trouble, temperament, or chronic lassitude and debility. It is only within recent years that a really sound engine has been available for auto-cycles, and to halve the capacity usually employed in these engines, and retain the same reliability, is no mean engineering feat. The *potential* ability of small light engines has always been realised, and many attempts to apply them have been made since the very early days of motor-cycles ; but though many such engines, such as the Motosacoche, the Clement, and the Wall Auto-wheel, have been ingeniously designed and beautifully made, their careers have been ephemeral.

A tiny engine must necessarily be on the tip-toes of its performance the whole time, and unless it has sufficient stamina to withstand this practically indefinitely, it will surely be a partial or complete failure. Some of the commercially made power units, while quite adequate for propelling a pedal cycle at a speed of some fifteen to eighteen miles an hour on the level (which is quite as fast as it is really comfortable or safe to drive a cycle of normal design) exhibit signs of distress if they are expected to cope with quite easy gradients of any sustained length without pedal assistance. The absence of any means of changing gear ratio is obviously much more keenly felt with engines of very small capacity than those fitted to motorcycles ; but considerations of cost and complication generally preclude the possibility of fitting a gearbox on a cycle attachment.

Incidentally, there is some tendency for the cult of the outboard to spread also to three- and four-wheeled vehicles, some of the simpler forms of which now consist merely of a combined body-chassis with very elementary springing and steering arrangements, with an engine-gear unit fitted, almost, it would seem, as an afterthought. While this form of design offers some interesting possibilities, expecially to the amateur constructor, it is by no means certain as yet that it is the best way of attaining the ostensible aim of a cheap and economical form of utility car.

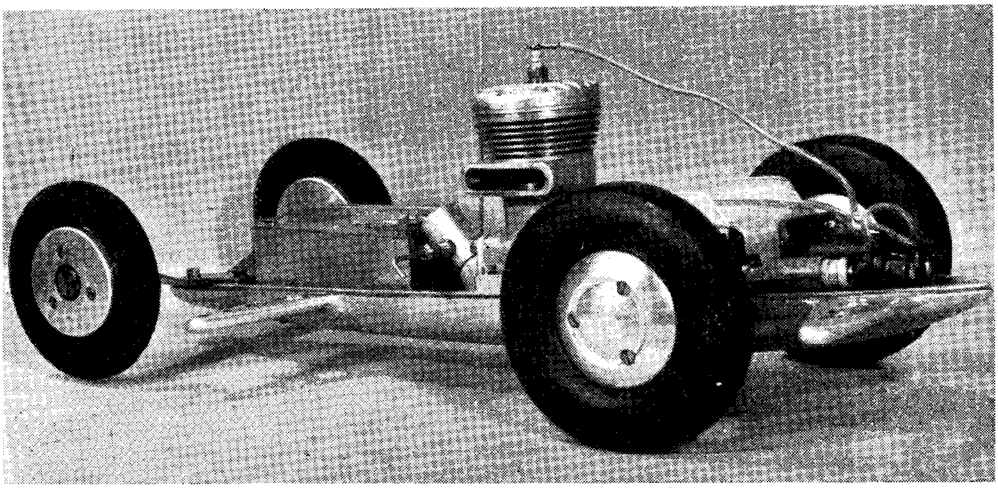
At the present time, any kind of vehicle which appears to offer a chance of promoting economy in road transport is fairly certain of being a popular attraction, but whether the present methods of satisfying this demand are really satisfactory, remains yet to be seen.

A Society Formed in Keighley

A society of model engineers has now been successfully launched in Keighley.

We have been asked to invite the hon. secretaries of the societies at Leeds, Huddersfield, Bradford, Brighouse and any others within reach of Keighley to forward their 1950 fixture-lists to the hon. secretary of the new society, Mr. Eric Wadsworth, A.M.I.Mech.E., 24, Granby Drive, Riddlesden, Keighley, Yorks, with a view to possible mutual collaboration. The new society has our best wishes for success.

MODEL CAR NEWS



The "Sabre" with body removed

IGNITION

by W. G. Rowell

IGNITION equipment on the miniature racing car is responsible for 95 per cent. of the trouble experienced when cars refuse to work at the various meetings. Furthermore, a certain amount of carelessness is apparent in many cases by the manner in which timing is carried out, and in the majority of cases the engine is not timed to best advantage. Just ask the average modeller what he is timed at, and in nine cases out of ten he will say, "Oh, about $\frac{3}{16}$ in. before top," or something near that. What a different attitude to that of the American "Speed Kings," who know to one-thousandth part of an inch, where all their various settings are, and rightly so. What a difference in speed they show by their sound and efficient methods.

The writer has had a vast practical experience of miniature racing motors, and over the years has gradually accumulated much knowledge on the subject of ignition, which he will try to pass on for the benefit of all engaged in British miniature motor racing.

It is to be assumed that the reader knows just how an ignition system operates, and we will not waste time on elementary principles. Let us take the various component parts of a spark ignition system one by one.

(a) Ignition Coil

This is the heart of the entire system and in the writer's opinion, the modeller will be well advised to purchase this item, rather than make one himself. There are at least three good racing type coils on the British market and all give excellent results. The average coil operates on a maximum of 4 V and consumes between 6 and 8 A when starting. This drops considerably at speed, however, to a fraction of an amp.

Nothing can be done to improve the performance of the coil, but care should be taken in the mounting of it in the car. One make of coil available is in a paxolin case, and fits into spring clips on the chassis. This type will operate at full efficiency hard up to the chassis frame. The cardboard case coil can, I have found, give trouble if mounted too near to the metal chassis, and is best mounted on a fibre or perspex stand, keeping the case of the coil at least $\frac{3}{16}$ in. away from earth. When soldering the wire connections to the tags *do not* keep the soldering iron on too long, otherwise you may cause damage by unsweating internal connections.

(b) Condenser

This little item is usually stuck on as an afterthought, but can be a nuisance if not fitted correctly. The capacity will be anything between 0.01 mfd. and 0.1 mfd. according to coil design and the advice of the manufacturers. The usual type of condenser used in this country are those made for radio work, which, whilst perfectly efficient, electrically, can cause trouble if not mounted and wired correctly. The condenser is of the metal clad type and of tubular construction. The connecting wires issue from each end, and are of single strand copper—the right stuff for snapping off at the wrong moment. These wires should be cut off and replaced with flexible copper insulated wire which will withstand vibration. The condenser should then be

mounted in a small brass clip and one wire connected to the chassis, whilst the other is taken to the moving contact point. It should of course be mounted as close as possible to the motor.

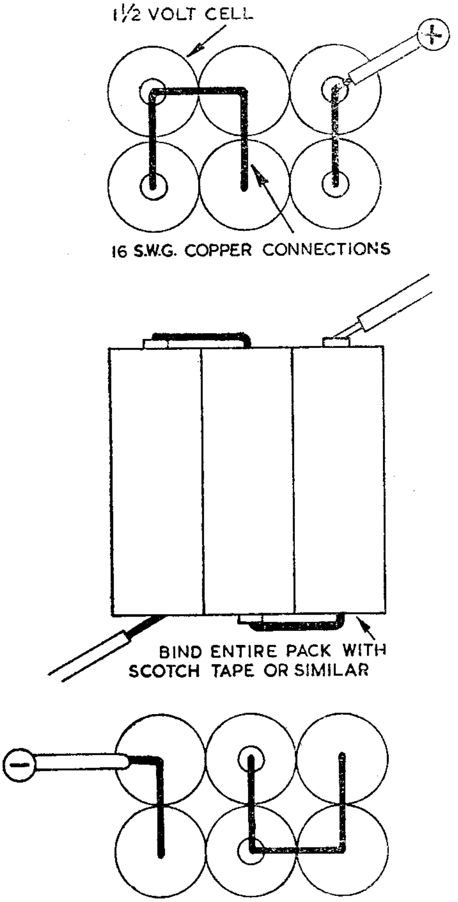


Fig. 1. *Pencell power pack*

(c) Ignition Switch

This item can be a straightforward panel mounting toggle radio switch. The type is very satisfactory although in view of nitrated fuels now in almost universal use calling for a fuel cutout valve to operate simultaneously with the ignition switch, a great deal of "wangling" is sometimes called for to link up the two items. A combined fuel/ignition switch in one unit is much more convenient and much lighter too. The writer will, with the editor's permission, describe one weighing only 1 oz. in the near future. The ignition switch is best connected to break the positive battery lead to earth.

(d) Contact Breaker

This is fitted ready on the engine. Spring pressure should be strong enough to prevent bounce at high speeds, although too strong a spring will take power to operate it, which will be more useful at the wheels. The spring is usually correct as fitted by the makers. The points themselves should make flat contact with one another over their entire surface. Make sure that the fibre heel which carries the moving point is free on its fulcrum pin and apply a thin oil. The points should be set to open a maximum of 0.005 in. You can set at 0.004 in. if your contact breaker assembly is in good condition, and has no play in the various parts. No point in lifting against the spring any more than is absolutely necessary.

The most important point to remember is, *do clean your points after every run* to ensure perfect contact. Remember you are using a low voltage and not 12 V as is used on a motor car set. The length of time the points remain closed during each revolution of the crankshaft is governed by the shape of the cam and cannot be altered easily. This dwell varies between 180 deg. to 270 deg. of crankshaft rotation.

(e) Sparking Plug

The modern 10 c.c. racing engine uses a ½ in. diameter long reach plug. This type of plug is especially designed to racing duty and must be chosen with care. It has come to the

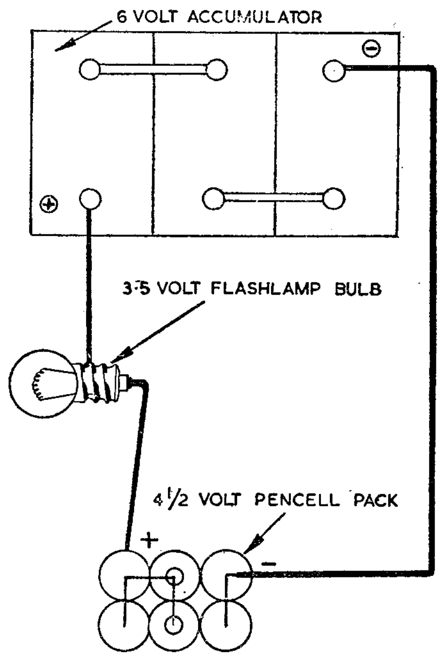
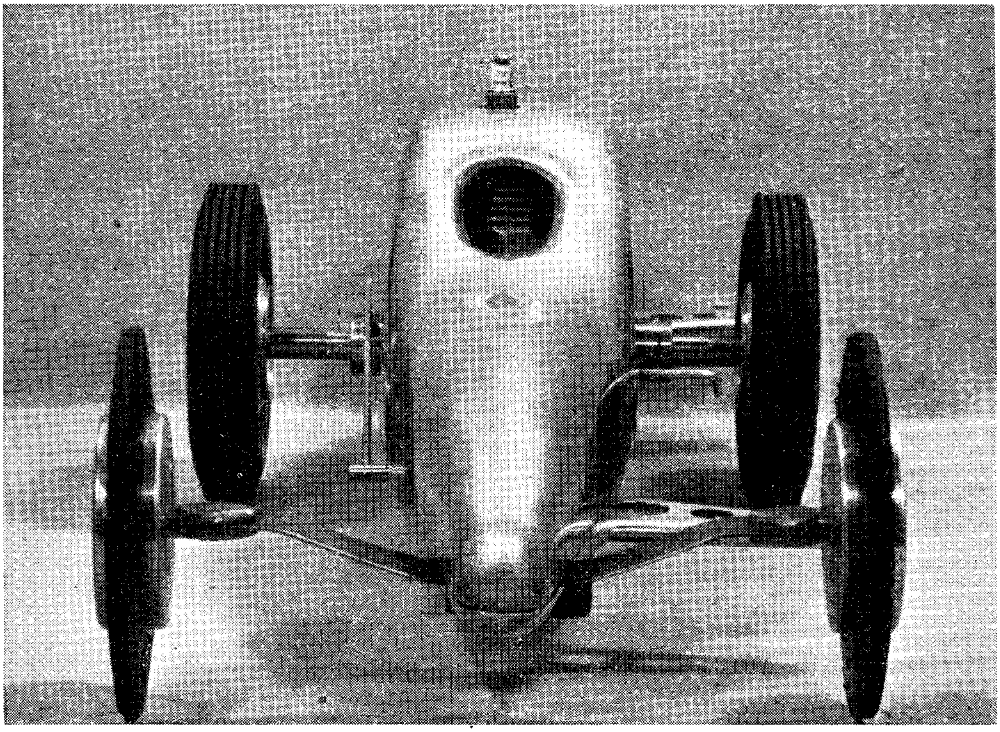


Fig. 2. *Pencell recharging gear*

writer's notice on a number of occasions that an engine of my design has refused to function on spark ignition ; consequently, glow-plug ignition had been adopted. In every case it was found to be due to an unsuitable sparking plug.

If, on pushing off your car you find it just keeps popping, and if it does start, running in a splutter-

ing manner, suspect a fouled plug. Some makes of plugs have a very small air space inside the body between the metal and the insulator. Racing engines start off running very rich, and in nine cases out of ten, the small space in the plug becomes full of oily fuel, which it cannot burn out before it peters out altogether. Choose a sparking plug with a large internal air space between body and insulator if you want to keep free of sparking plug trouble, and get easy starting. The plug gap should be set at exactly 0.014 in. for best results.



Frontal view of the "Sabre." Note the vent for efficient engine cooling

(f) Battery

This item must be good and reliable for successful and consistent running. A potential of 4 V is required for easy starting although some modellers seem to get away with 3 V. Tests carried out by the writer on a 3 V supply have not been too successful as regards starting and a minimum of 4 V is recommended. I should make it clear, perhaps, what I mean by a minimum of 4 V, lest someone sticks a 6-V accumulator across the coil with messy results.

If you use a 4-V lead-acid accumulator of which a special light type is available for model car duty, the maximum voltage is 4 V. Should pencells be used a voltage reading of $5\frac{1}{2}$ V is safe as this drops to under 4 V under load.

The use of pencells for ignition purposes is becoming more popular in this country now, as the Americans have proved for a long time that this form of battery is ideal, being light in weight and readily charged, or more correctly, depolarised.

To make up a pencell pack, you should buy a few 3-V pencells from your local electrical dealer. The writer uses either "Drydex" or "Ever Ready" but other makes will probably be as good for the purpose. The pencells are snapped into two pieces, and you will then have a number of $1\frac{1}{2}$-V cells ready for making up your pack. You can use 6 cells as shown, or you can use 9 if you wish, but wired up to give a $4\frac{1}{2}$-V supply, the entire assembly to be wrapped with Scotch tape or similar insulating material.

Before use it will be as well to depolarise the battery, and for this you will need a 6-V d.c. supply, and a flashlamp bulb. A small 6-V accumulator is ideal for the purpose. Connect up as in Fig. 2 when the lamp will glow with a brightness depending on the difference in battery potentials. Within a few minutes the lamp will go out as the pencell pack rises in voltage. The battery is now ready for use, and will probably give a reading of $5\frac{1}{4}$ V. In this condition ignition will be tip top, and starting dead easy when you will cut down your ignition troubles to an absolute minimum. Pencell packs vary in their length of useful life, but an average pack should last two or three months with care. A pencell pack should be depolarised after every run.

(g) Timing

The modern racing engine develops maximum power at between 17,000 and 18,500 r.p.m., and ignition setting at these speeds will be between 0.180 in. and 0.190 in. before T.D.C. The timing of ignition is vital and is tied up with the gear ratio of the car. Timing can only be done properly with proper equipment, and the most useful tool to get hold of for timing is a dial indicator reading in thousandths. These are used on lathe work for setting accurately, and are obtainable from most toolshops. Get one that will give a reading up to about 0.240 in. The dial is usually graduated into 0.040 in. for one revolution of the pointer, so that four complete revolutions will give a reading of 0.160 in. Make sure that the plunger will enter the spark plug hole in the cylinder head before you buy it. Fig. 3 shows how to mount the gauge which should be clamped rigidly to the cylinder so as to give an accurate reading.

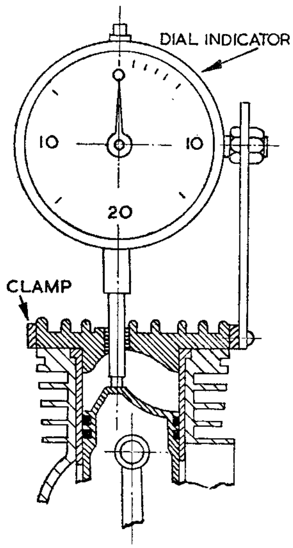


Fig. 3. Method of measuring piston-travel with dial indicator (diagram only)

To make a start at finding the best position for firing we had better set the piston at 0.140 in. before T.D.C. for the initial tryout. Now it is essential to know exactly when your points are just opening and for this we want the flash light bulb again and a $1\frac{1}{2}$-V battery. Wire these in series with the points (Fig. 4), when by turning the driving wheels of the car, the bulb will go in and out as the points close and open. By turning the wheels so that the piston is travelling up the cylinder, a point will be reached where the lamp will go out—this is the exact spot at which the dial indicator reading should be noted. Continue turning the wheels slowly counting the divisions on the gauge until top dead centre is reached. To start off this should give a movement of 0.140 in. Now away off to the race track and have a trial run and note the speed *accurately*. Advance the timing 0.005 in. at a time and note the speeds. A steady increase in speed should come right up to about 0.180 in. to 0.190 in., provided, of course, that the weight of your car and the gear ratio is correct.

Let us suppose, however, that we have found that maximum speed is obtained at a setting of 0.150 in. B.T.D.C. and any increased setting causes a reduction in speed. What then can we do now? This indicates that the engine is unable to attain its proper speed due to either too high a gear ratio or too heavy a car, or both.

Let us do a spot of calculation to clear the issue a bit. Wheels $3\frac{3}{4}$ in. diameter, which, at the speed we recorded (93 m.p.h.) works out at about 8,500 r.p.m. Let us note the gear ratio—yes $1\frac{3}{4}$ to 1—which, discounting slip, brings our engine speed up to nearly 15,000 r.p.m. This engine speed is too low for maximum output, so we must therefore take steps to reduce the weight of the car, and thereby let it attain higner revs. or else increase the gear ratio to say 2 to 1. This ratio will allow the engine to run at 17,000 r.p.m. at 93 m.p.h., which will allow of an advance in ignition, and being lower geared will be able more easily to climb up nearer the 20,000 r.p.m. mark which is where we want to be. Once we are reaching these speeds, we then have other factors to take into account, such as perfectly balanced moving parts, and minimum friction to be offered the gas flow in the motor. These things are, however, too big in themselves to be included in this article, which is to deal with the electrical side of the power unit.

Readers will now, I am sure, realise just how important is the timing of the ignition, and that maximum performance will never be obtained by hit and miss methods. One must understand quite clearly what the goal is, and move towards it step by step in a patient and intelligent manner.

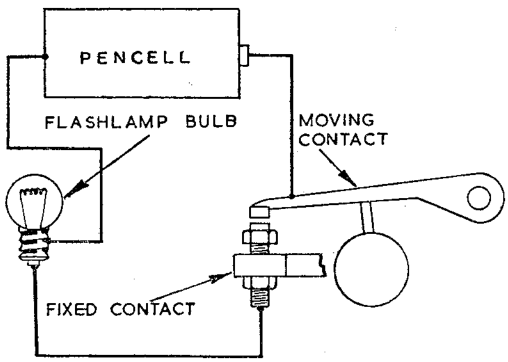


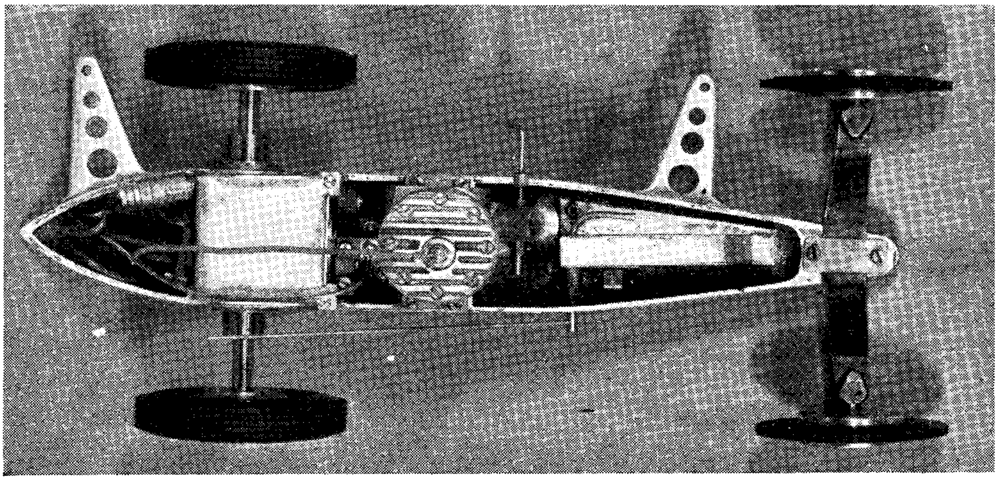
Fig. 4. Visual aid to point setting

The wiring up of the ignition components should be done with multi-strand copper extra flexible insulated wire. The writer always uses a silky type of copper wire of the same material as is used between the carbon brushes and holders on car generators. This is passed through neoprene tubing, and all joints soldered after which the end of the tubing, joint and tag, are wrapped with thread and painted over with a coat of coloured aeroplane proofed dope. This is a very sound strong joint.

Fault finding—Fault finding is easy if attacked the right way. If you have built your own car

you will know your ignition set-up thoroughly, which will help. If your motor refused to pop on being pushed off, provided of course that it is getting its fuel, it should be checked as follows :

Battery—Check voltage, which should read, 4.75 if newly depolarised. If lower reading is given stick charging wires across and wait until lamp goes out. If voltage is now high enough proceed to :



Points—Check they are opening, and are clean. Open points and after having switched on the current remove sparking plug lead, and by quickly shorting the moving point to earth with a screw-driver a spark should jump a ¼ in. gap to the chassis. If this occurs, and the spark is intense you can take it that the sparking plug is at fault, and should be replaced as a check. If no spark is present, with points open and switch on, check if voltage is present at the points, using the voltmeter. If no reading is given, check the wiring, which, if found all right, points to a faulty coil or condenser. A weak spark often indicates condenser trouble.

If your car starts with difficulty, and refuses to run smoothly and on stopping you remove the plug which is found to be partly fouled with oil, this indicates deficient ignition.

Glow-Plug Ignition

This form of ignition is used very little on miniature racing cars. The power output given by the engine is usually only a small amount less than given by spark ignition. The trouble, however, in a car, is that one is not able to fix or control the point of firing as is the case with spark ignition. Glow-plug engines must be allowed to run at extremely high speeds and a gear ratio of nothing less than 2 to 1 should be used so as to allow engine speeds over 17,000 r.p.m.

The glow-plug engine has attained terrific popularity in the model aeroplane world where speeds equalling spark engine speeds have been attained. The engine can, however, be loaded to the correct amount by changing propeller sizes to this end. The equivalent in the case of the car is more expensive, however, as this means change of gear ratio to find the best loading. Running a glow-plugged car which is over geared, is equivalent to running a glow-motor on an over-sized propeller which will never give full power. Starting a push car on glow-plug can be difficult as the battery is usually carried on the push stick and connects to the car by means of a pull-out plug.

Model Racing Cars at Bolton

The Bolton and District Society of Model Engineers had a very successful opening meeting on Sunday, May 21st.

The 2.5 c.c. and 5 c.c. class cars suffered badly from a wet track surface and the speeds were well below those expected.

However, the track dried off in time for the 10 c.c. class and the "century" was broken on several occasions. Mr. F. G. Buck was timed at 111 m.p.h. in the open class with his "Custom Proto" McCoy but presented his prize to the next fastest car amongst the "own" constructed.

Results were as follows :—

10 c.c. Open			
F. G. Buck	Meteor	McCoy	111.07 m.p.h.
G. E. Jackson	Derby	Dooling	105.84 ,,
10 c.c. British			
F. G. Buck	Meteor	Own	102.23 ,,
A. Nash	Derby	Own	97.79 ,,
J. W. Riding	Bolton	Rowell	97.79 ,,
5 c.c. Open			
J. Clayton	Bolton	E.T.A.	68.15 ,,
W. Hetherington	Hooton	E.T.A.	65.19 ,,
2.5 c.c. Open			
J. R. Parker	Meteor	E.D.	48.95 ,,
H. Howlett	Meteor	Oliver	48.0 ,,

Here ———— and ———— There

by "Clubhound"

As a result of my remarks some little time ago regarding the formation of a Dooling club, I can now include full details as supplied by the Southern Area representative, that very active enthusiast, Mr. C. M. Catchpole. Just in case I fail to do justice to the scheme in my own words, here is the griff, as supplied :—

The Dundee Speed trophy

The Dooling Enthusiasts' Club

During conversations at various meetings around the country last season, it became apparent that owners of Dooling engines had a feeling that it would be to their advantage if some form of club was started, somewhat on the lines of the Bentley Drivers' Club, which would enable them to keep in touch with one another, and also, promote the exchange of ideas, etc., and make them feel a little less like outcasts and criminals. It was recently decided that this club should be formed as soon as possible in time for the 1950 racing season, and the two signatories of this letter have agreed to act temporarily as Southern and Northern representatives. When the club has

The Dundee and District Miniature Race Car Club's stand at the recent exhibition of the Dundee and District Society of Model Engineers

a reasonably large number of members, these two representatives will retire and a proper constitutional vote will be taken.

Membership is by invitation only, but any member can propose for membership any Dooling owner whom he considers complies with the club requirements, the chief of which are possession of, and a genuine enthusiasm for, Dooling products, allied to a desire to achieve the highest possible speeds and a sportsmanlike outlook on the hobby in general. A committee will be formed to "vet" all member's qualifications and ensure that these conditions are fulfilled.

It is intended that wherever possible at all large meetings and open days a team shall be entered for all events. A cup for the club has already been presented by Mr. C. M. Catchpole, and will be competed for this year. The rules have yet to be finalised, they will not involve a separate race, but will probably be taken from the competitors' times over the whole of the season.

The club badge to be worn on the cars will consist of a letter "D" about ¾ in. high, with a cross bar superimposed in colour, this colour to indicate the speed which has been officially recorded. A range of colours for both "29" and "61" is at present being worked out.

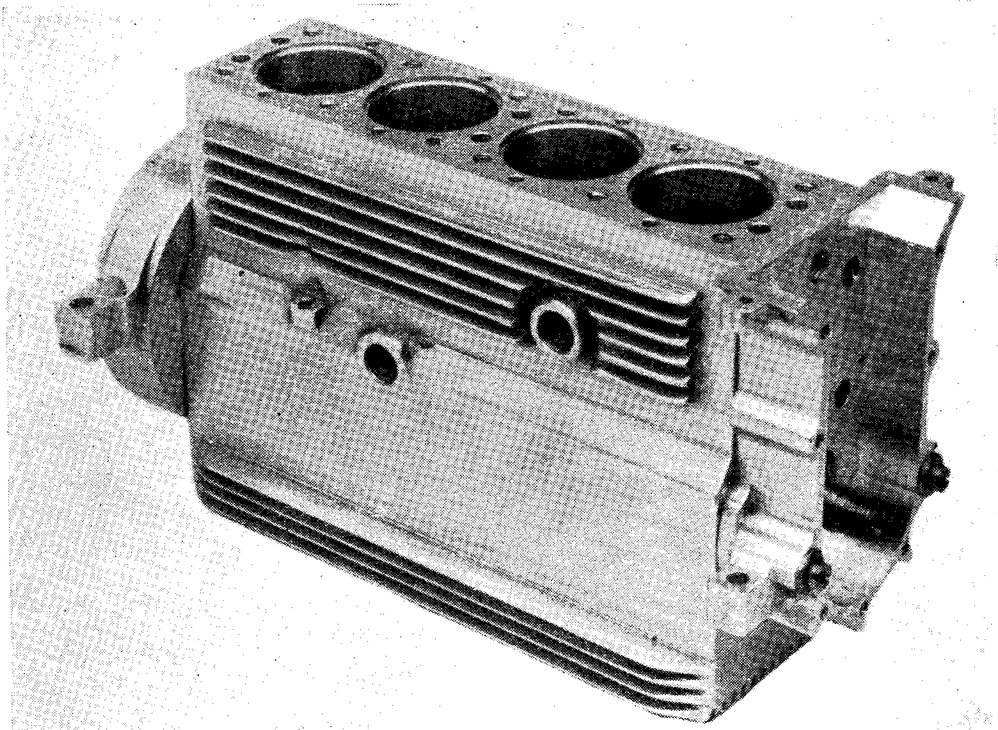
The subscription is 10s. 6d. per annum, surplus funds at the end of the year to be expended on trophies, etc.

It is emphasised that the Dooling Enthusiasts' Club is not intended in any way to cut across the members' own local club—it is a national get-together of Dooling owners. Rules are at present being printed, and a copy will be sent to all members shortly.

Northern Representative: I. W. Moore, 2, Bridge Street, Derby.

Southern Representative: C. M. Catchpole, 26, Rutland Court, Queen's Drive, London, W.3.

The very best of luck, chaps, and rapid motoring!

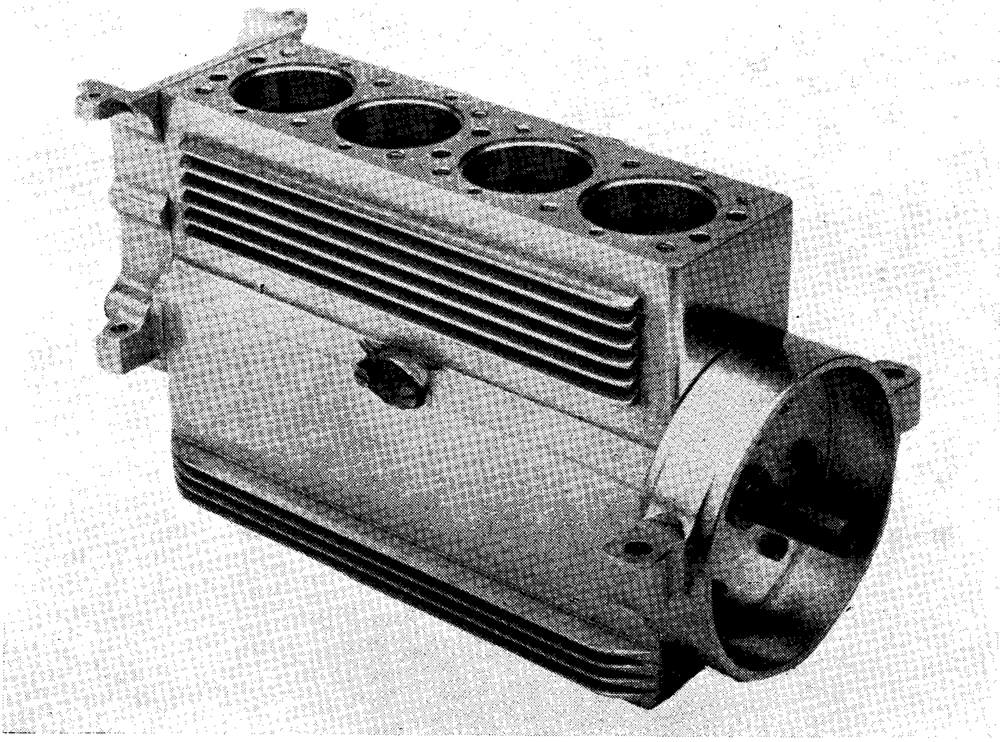


A three-quarter front view of the Jones 10-c.c. four-cylinder twin o.h.c. racing engine in the process of construction

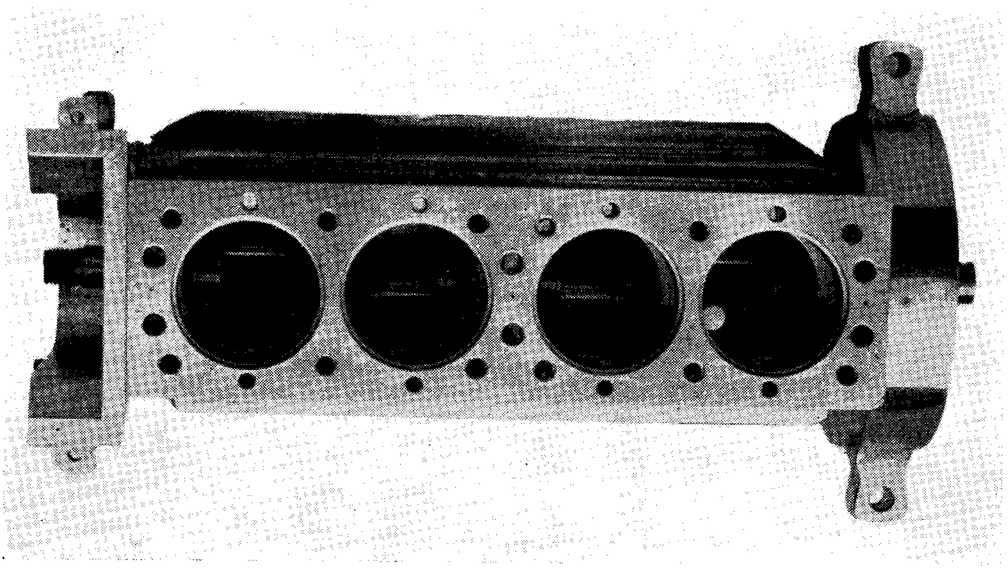
Just to give intending competitors a morsel to chew on in the meantime, here is the magnificent silver rose bowl which somebody's wife is going to have the pleasure of cleaning after Saturday's (June 18th) 10 c.c. speed event at Dundee. It should be a ding-dong competition and believe me, chaps, the boys of the home track are not going to sit back and watch the fun. Every indication points to a most enjoyable weekend as the organisers are determined that it shall be a really first-class meeting.

The Bradford and District Model Car Club opened recently at their 70-ft. concrete track at Yeadon Aerodrome. No spectacular speeds were put up, but some amusement was created for between two and three hundred spectators by a car, owned by Mr. Ashe, which turned completely over and covered about half a lap at 80 m.p.h. on its back!

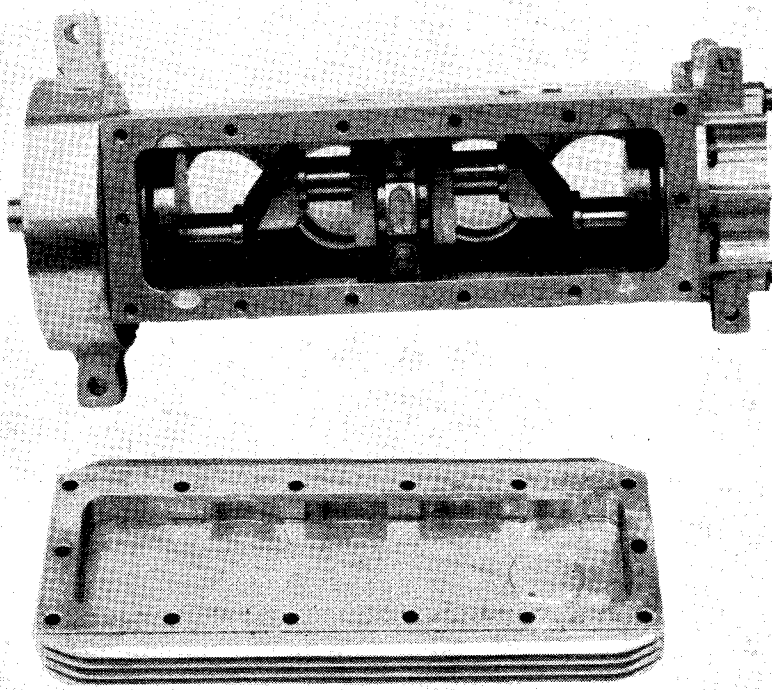
During the winter months the club entertained



A three-quarter rear view of the motor, showing the flywheel/clutch casing



From the outside looking in, so to speak



This view, with the sump detached, should give some idea of the excellence of the craftsmanship involved. Remember, everything from the solid!

youth movements, scouts and model engineering societies on their indoor tracks. They meet on the first and third Fridays in each month, but they also have a rota system in operation for the track at Yeadon whereby some responsible member is present every week. An open event is to be held on July 2nd and further particulars of the club and its activities may be obtained from the Hon. Secretary, Mr. John S. Moore, 11, Sefton Grove, Bolton, Bradford.

My reference to the activities of F.G.B. brought home a well earned clip on the button in the form of a truly magnificent literary bomb. And to think that he has tried to convince me, on more than one occasion, that he is no writer!

I dare say quite a number of readers (including F.G.B.) were puzzled by my reference to this well-known modeller. Well, so many of you have expressed concern at F.G.B.'s widened interest that I thought I'd create an argument and give everyone a chance to do a spot of simmering.

Now, in point of fact, F.G.B. has been *very* fair and has laid his cards on the table face upwards. His main reason for running an American car was to prove that "in this country, one needs *nothing* more than cash and contacts to get results." F.G.B. points out that, of his eight cars of assorted sizes which he hopes to have running this season, seven are *entirely* all-British.

Those of you who intend entering models in this year's MODEL ENGINEER Exhibition are reminded that the weeks are slipping by pretty rapidly. Entry forms are now out, so come along, chaps, let's see a really representative entry of four-wheeled track-busters at this year's show. Don't forget the date, August 9th-19th inclusive; venue, the New Royal Horticultural Hall, Westminster.

I have just been afforded the opportunity of inspecting the block and crankshaft assembly of the 10-c.c. twin-o.h.c. four-cylinder engine to which I referred a few weeks ago. This is the work of Mr. W. P. Jones, of Alfa Romeo and Bugatti fame and, like his other models, is first-class in every sense of the word.

The block is machined entirely from the solid, and the crankshaft, an exquisite piece of work also from the solid, runs in two ball-race end bearings and a white metal centre bearing. The twin cams will be driven through a chain of gears from the front end of the crankshaft, from where also will be taken the drive for the supercharger.

The housing at the rear of the block will carry the flywheel and automatic centrifugal clutch assembly.

Mr. Jones tells me that the engine will be fitted to a free-lance Grand Prix-type chassis of his own design with fully independent suspension, and if I know anything of the said Mr. Jones, the detail work is likely to be pretty terrific.

Yes, it looks as though you've started something, Jonah; perhaps, in the not too distant future, a new formula for model cars, eh?

IN THE WORKSHOP

by "Duplex"

65—Bending and Fitting Pipes

THE bending of copper, brass and steel piping is an operation the amateur is often called upon to perform, and the results are not always satisfactory. Machine methods of bending undoubtedly give the best results, and, in fact, are almost essential where a uniform series of bends is required. Nevertheless, bending by hand will be found quite effective for all ordinary work, and moreover, the necessary equipment already exists in the workshop ; this consists of commonplace mechanical components to serve as formers for bending the tubing.

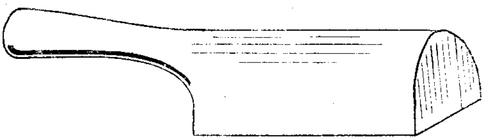


Fig. 1. *A plumber's dresser*

In this article simple methods of bending will first be described. This will be followed by some notes on fittings and their attachment to pipes. Finally, full instructions will be given for constructing a commercial bending machine, designed especially for use in the small workshop. This machine will not only deal with pipe work, but will also be found capable of making bends in metal of widely varying cross-sections.

Bending Pipes by Hand

Pipes having an external diameter of $\frac{5}{16}$ in. or less may be bent unfilled. That is to say there is no need to load the pipes with one of those substances used by coppersmiths to fill pipes before bending. Sand, lead, resin and "Cerrobend" are all used as filling materials. The purpose of the filling is to prevent kinking and deformation, and the choice of material will depend upon whether the pipe is to be bent in the hot or cold state. Thus, steel pipes of large diameter, as are used for motor cycle exhausts, are filled with sand. This practice applies only to the making of a single pipe with simple equipment, for the factory would employ a bending machine for this purpose.

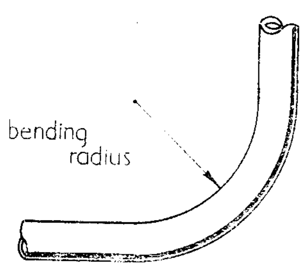


Fig. 3

Small copper pipes are bent cold, but those of large diameter may be filled either with lead or "Cerrobend" ; the latter is a commercial alloy consisting of Wood's metal and melts at a temperature much below the boiling point of water.

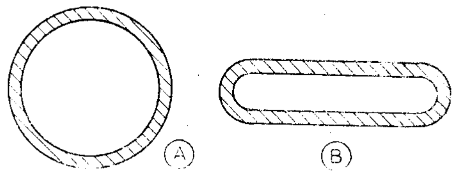


Fig. 2. *Section of pipe after* : (*A*) *bending to a curve of correct radius* ; (*B*) *bending to a curve of too small a radius*

Resin has been mentioned as a filling, but, today, it is seldom used owing to its liability to break up at the point of bending.

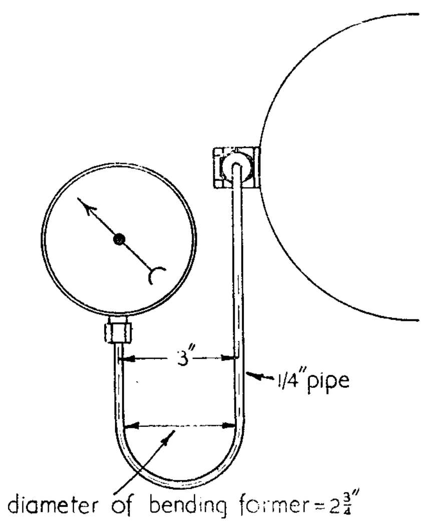


Fig. 4

A method at one time used by plumbers when bending lead piping was to insert a tightly coiled spring into the pipe to keep its section uniform during the bending process.

Bending Formers

It is bad practice to bend pipes without using some type of former, and failure to do so will inevitably result in the bend becoming uneven. There is no need to be at a loss for a suitable former, for the workshop abounds in objects which will serve admirably for this purpose. To name but a few: cone pulleys or pulley castings, the circular tables from drilling machines, off-cuts from steel bar, and even glass bottles, though these latter must be well wrapped in rag before being gripped in the vice.

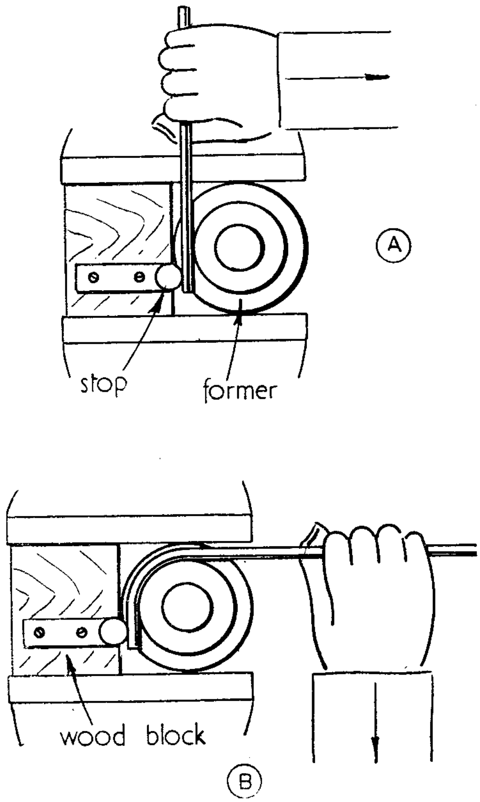


Fig. 5. Bending with improvised equipment

Bending Unfilled Pipe

Before any bending can be carried out the pipe must be prepared. This involves three separate operations: cutting to the approximate length required; straightening; and finally annealing if the material is copper or brass. The length of pipe required is best measured by taking a piece of stout gauge copper wire and bending and fitting to the actual run of the pipe. The bends should be made easy, so that the pipe can readily be bent to

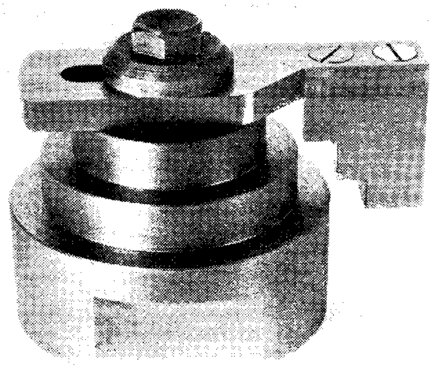


Fig. 6a. The bending block

shape. After the wire has been bent to fit the work, it is straightened out and measured, an allowance of an extra inch or so being given for the bends in the pipe itself.

The pipe is now straightened by rapping it on an anvil or a lead block. A metal hammer must not be used for the purpose for this would only cause dents in the pipe; instead a piece of hardwood, about 1 ft. in length, and some 2 in. wide by 1 in. thick, is employed to strike the pipe; meanwhile, the work is held up to the eye so that the position of any kinks can be detected. Plumbers and sheet-metal workers use for this purpose the tool illustrated in Fig. 1 and known as a dresser. The best are made of boxwood, but beech will serve equally well. If much work, either on pipe or sheet metal, is contemplated, the making of this tool will be well worth while.

The next step is to anneal the pipe, should it be made of copper. This is done by playing the flame of a blowlamp or brazing torch along the pipe till it assumes a bright blue colour. There is no need to quench the work in water, as this has no beneficial effect on the annealing process

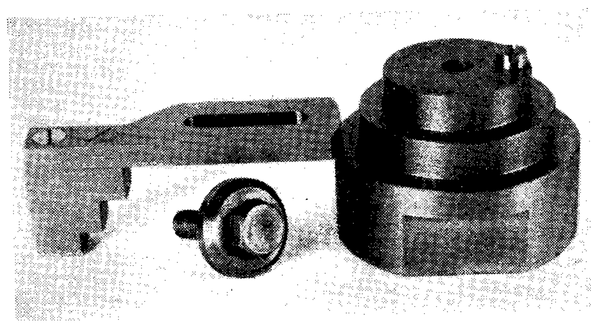


Fig. 6b. The bending block dismantled, showing the component parts

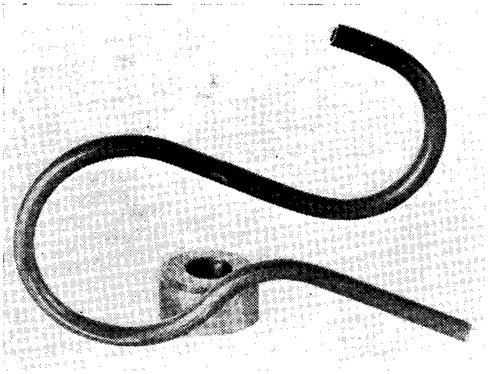


Fig. 7. An example of pipe bending made on the bending block

but merely cools the work quickly. In passing, it should be observed that badly bent pipes should be annealed before being subjected to the straightening process described, for the more malleable condition of the metal brought about by annealing greatly facilitates the subsequent work of straightening the pipe.

Mild-steel pipes do not need annealing, for ductile metal has to be used for the manufacture of these pipes by an extruding process. Moreover, there is but little tendency for metal of this kind to become work-hardened during bending operations.

Brass pipe is usually made from what is known as bending-quality brass, and this material, again, suffers no material physical alteration when being worked.

Pipes made from aluminium alloys need different kinds of treatment. The soft alloys need no annealing, but this process is necessary with the harder varieties such as duralumin. A rough method of assessing the correct temperature is to heat the metal until the application of a piece of yellow soap to the work turns the surface black ; but it must be emphasised that this procedure is merely empirical and is by no means necessarily the best method for all aluminium alloys. When both the maker and the specification are known, it will be better to consult the manufacturer in order to obtain authoritative instructions as to the proper procedure.

The pipe is now ready for bending. A former of the correct diameter is gripped in the vice and the pipe is bent round the former by being pulled with the hands. The selection of a suitable size of former depends upon two factors ; the first and the more important of these is the size and wall thickness of the pipe. These dimensions will decide the minimum radius to which a pipe can be bent freehand without its cross section becoming flattened. In Fig. 2 a section of pipe is shown : *A*, after being bent correctly, and at *B* when the pipe has been flattened by being bent to a curve of too small a radius. Apart from the unsightly appearance produced, it will be obvious that a pipe flattened in this way will have its bore constricted ; it is, however, possible to make good the damage, in part at least, by compressing the pipe bend between the jaws of the vice. Clams must, of course, be used on the vice jaws to prevent injury to the surface of the work.

Experience has shown that convenient minimum radii for bending unfilled pipe of No. 20 s.w.g., as commonly used for fuel lines, are as

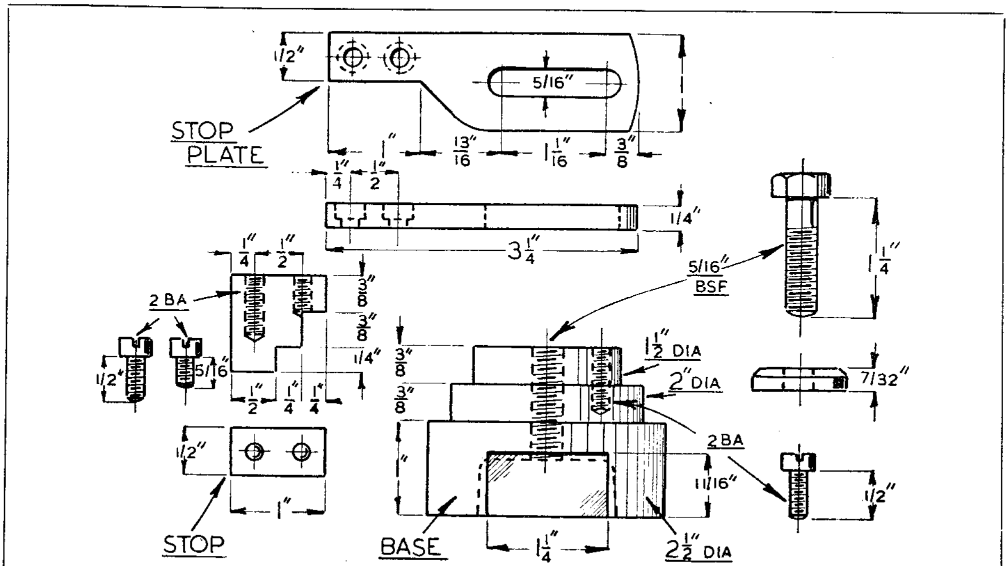


Fig. 8. Details of bending block

shown in the table below :—

$\frac{1}{8}$ in. outside dia.	$\frac{1}{4}$ in. radius
$\frac{3}{16}$ in. ,, ,,	$\frac{1}{2}$ in. ,,
$\frac{1}{4}$ in. ,, ,,	$\frac{3}{4}$ in. ,,
$\frac{5}{16}$ in. ,, ,,	1 in. ,,

These measurements are taken from the centre of the circle to the inside of the bend, as shown in Fig. 3.

The block has two flats at its base to enable the appliance to be gripped in the vice. The device illustrated will bend to radii of $\frac{3}{4}$ in., 1 in. and $1\frac{1}{4}$ in., and an example of pipe bending made upon it is shown in Fig. 7. Detailed working drawings of the appliance are given in Fig. 8. The making of this pipe bender calls for little comment, as the work is quite straightforward.

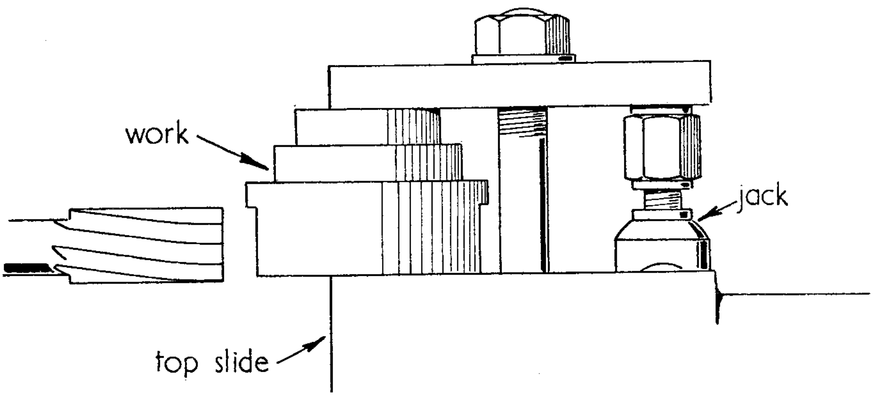


Fig. 9. Mounting the base block, end-milling the flats

As rectangular bends are so often used to change the direction of the run of a pipe, these figures should be found of practical value.

The second factor which decides the size of the bending former is the disposition of the pipe work itself ; for example, a pressure gauge has to be connected to an air reservoir in the manner illustrated in Fig. 4. The diameter of the pipe used is $\frac{1}{4}$ in. and the distance between the pipe centres is 3 in. The former employed for bending must then be 3 in. — $\frac{1}{4}$ in., that is $2\frac{3}{4}$ in. diameter as represented in the drawing.

If the length of piping on either side of the bend is sufficient to allow both hands to obtain a firm grip, the bend can be made without difficulty. Often, however, the standing portion of the pipe is so short that it is impossible to hold it with one hand against the leverage exerted by the other. In these circumstances, a work stop must be contrived. This may take the simple form of a piece of wood in which a steel stop pin is fixed. The wood base is gripped in the vice beside the former and is adjusted so that the pipe is lightly gripped between the stop and the former as shown in Fig. 5A and B. This arrangement allows the bend to be made quickly and without difficulty.

A Bending Block

A neat and self-contained bending block may be made from a three-step cone pulley casting such as can be obtained from Mr. W. H. Haselgrove. The illustrations, Fig. 6A and B, show the construction clearly, and it will be seen that an arm carrying a stepped stop-piece is attached to the top of the block. The arm, which is free to slide radially on a dowel pin screwed into the block, is secured, after adjustment, by a hexagon-headed $\frac{5}{16}$-in. B.S.F. screw.

The base, with the exception of the recess on the underside, is machined all over to the dimensions shown in the drawing. The two flats on either side of the base are, for preference, formed by end-milling, or by fly-cutting, in the lathe. To enable the vice to obtain a firm hold, care should be taken to form these flats to lie parallel with one another.

The work can usually be machined by mounting it on the toolpost stud fitted to the top slide, but if this stud is not long enough for the purpose a clamping piece can be used instead as shown in Fig. 9. One of our lathes is regularly used in this way, and to avoid the multiplicity of packings that would otherwise be required, a small screw-jack with a flat top is employed to support the free end of the clamping strap, as shown in the drawing.

If the part is gripped under the tool clamp on the lathe top slide, the slot in the stop plate can also be end-milled instead of being formed by drilling and filing.

The stop itself must be formed by hand unless a shaping machine or power hacksaw is available for cutting the steps. A hacksaw machine, now awaiting description, has recently been constructed for doing work of this kind as well as for cutting up materials ; this machine not only saves much time, but it can be relied on to cut much more accurately than the ordinary hand hacksaw.

The heads of the two 2-B.A. screws for securing the stop-piece to the arm should be made a close fit in their counterbored holes, and the dowel screw should also fit accurately in the slot formed in the arm. For this reason it is better to make these screws specially, rather than to rely on commercial screws which commonly have heads of varying diameter.

Using the Bending-block

The method of using the bending block is essentially the same as that illustrated in Fig. 5. The pipe is placed against the appropriate step, and, after the stop has been adjusted to grip the pipe, the central clamping screw is firmly tightened. It will be found that the pipe can now be readily bent to the required curvature in the manner illustrated in the drawing.

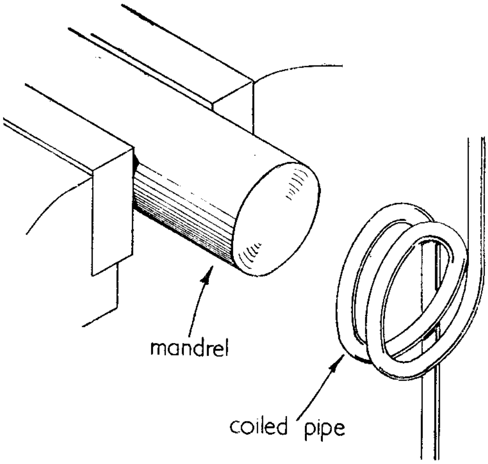


Fig. 10. Method of bending a series of coils on a pipe

If a copper pipe is well annealed it will cling closely to the former while being bent ; on the other hand, if the annealing has not been well done, or the pipe has begun to harden from being manipulated, the work will spring away from the former. When this happens, the copper must again be annealed before further bending is undertaken.

When two bends have to be made close to and at right angles to one another, it is best to begin by making the bends in the same plane and then to twist one of the bends into a position at right angles to the other. Such a procedure is much simpler than attempting to form the individual bends at right angles to one another.

It is sometimes necessary to put an anti-vibration coil in the pipe which, in a motor car, leads from the fuel tank to the carburettor. The coil is usually composed of two full turns, and may be made quite easily by bending the pipe on a piece of round bar held either horizontally or vertically in the vice as shown in Fig. 10.

Bending Loaded Pipe

The smaller sizes of piping can be bent readily round formers, but the provision of suitable simple equipment to deal with pipes of $\frac{3}{4}$ in. diameter and upwards is likely to be beyond the capacity of a small workshop. However, that need not stop those who wish to do so from bending the larger diameter pipes. With a little care, and an appreciation of the physical conditions in the pipe itself, good work can be turned out with no more elaborate apparatus than a strong fork-shaped piece of wood to serve as a bending block. The fork of a growing tree is admirably suited to the purpose, and, in the past, when engaged in motor cycle racing, we regularly used this method for bending steel exhaust pipes of a diameter of 2 in. or more.

Before bending is started, the pipe must be filled and, in addition, a wire template of the bend must be made to act as a guide during the bending operation.

Whilst lead may be used for loading short lengths of the smaller sized pipes, the cost of filling a large pipe would, at the present time, be prohibitive. Since, however, a sand filling is equally satisfactory for either copper or steel piping, and as this substance will withstand heating, the process of bending a sand-filled pipe will be described.

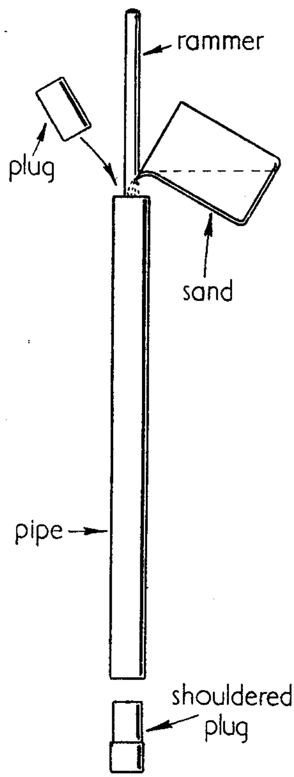


Fig. 11. Loading a large pipe with sand

In the first place, two metal plugs must be made. One of these is shouldered and is firmly driven into the pipe as represented in Fig. 11. The pipe is now stood upright, and dry sand, preferably silver-sand, is poured into the pipe. The pouring must be carried out by stages and the sand is meanwhile well rammed into the pipe. During the pouring operation, the pipe is bumped on its plugged end and well rapped with a piece of wood to assist the sand in forming a compact mass within the pipe. When the pipe has been

filled, remove just sufficient of the sand to allow the second plug to enter for about 1 in., then hammer the plug home. Both plugs should be made to enter the pipe for rather more than 2 in. for it is sometimes convenient to be able to hold the pipe in the vice by gripping one of the plugs.

The wire template is now applied to the pipe to ascertain the point where the bending should start. After this point has been marked with a pencil, the pipe is gripped by one end, either in the vice or in a stout wooden fork, and a blow lamp is applied to the pipe on the outer side of the start of the bend.

It is best to do the bending in a subdued light, or even in semi-darkness, for it will then be easier to judge the temperature reached. When the pipe is at a medium red-heat, the end is pulled round, but this must not be carried too far or kinks will form on the inside of the bend as shown in Fig. 12. If they are not too prominent, these kinks can be hammered back to restore the symmetry of the pipe, but when the pipe has been badly distorted it is almost impossible to restore the even surface of the metal. It is advisable to deal with these kinks as they occur, rather than to wait until the bending has been completed.

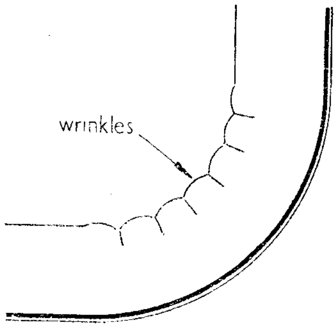


Fig. 12. Showing deformation of pipe wall resulting from over-bending

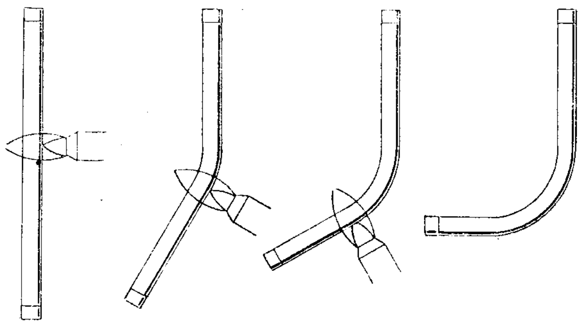


Fig. 13. Stages in the heating and bending of a large pipe

The blow-lamp is next applied a little farther along the pipe, and the bend is extended by again pulling on the free end of the work. Fig. 13 shows diagrammatically the successive stages in bending a steel exhaust pipe, and it will be clear that, on the outside of the bend, the metal is being continually stretched whilst on the inside of the curve the metal is being subjected to compression. It is this compression, when excessive, that causes the pipe to bulge and wrinkle in the manner illustrated in Fig. 12.

After the bend has been completed, and any wrinkles hammered into place, a file may be used, with discretion, to clean up any blemishes remaining on the pipe.

The golden rule in bending pipes of large section is to make the bend in easy stages, and to keep applying the wire template to the work, for this will enable any errors to be corrected before they have become too pronounced.

If a blow-lamp is used to anneal a copper pipe which has been loaded with lead, care must be taken to avoid pulling on the pipe immediately the flame is removed ; for the lead, at the point of heating, may still be soft, and not in a condition to keep the pipe from kinking at the point of bending.

For the Bookshelf

Early British Railways, by Christian Barman. (Penguin Books, Harmondsworth, Middx.). 40 pages, size $4\frac{3}{4}$ in. by $7\frac{1}{4}$ in., with 16 plates in colour. Price 3s. net.

This is a delightful little book, a pocket history that is different, a worthy addition to the "King Penguin" series. The main emphasis is not on the recounting of historical facts which are already well known ; rather, the author has contented himself with a review of the difficulties and problems faced and overcome, in spite of bitter opposition, by the pioneer railway builders, and an appreciation of the stupendous results achieved. Written with deep understanding, born of many years of experience on railways, and in impeccable English, which is so refreshing in these days of slipshod and mutilated language, Mr. Barman's story is a real pleasure to read, from start to finish.

The plates have been taken from a number of different sources, and they include some of the well-known Ackermann lithographs ; they are beautifully reproduced and are well worth collecting together, reprinting on one side of the paper only and issuing in a separate booklet.

Any Call for a $2\frac{1}{2}$-in. Gauge Engine?

by "L.B.S.C."

SEVERAL correspondents have recently called your humble servant over the coals on the tender, for neglecting the claims of $2\frac{1}{2}$-in. gauge, saying that there are many who, like themselves, haven't sufficient track space, equipment, finances, or facilities, or any combination of same, to build a $3\frac{1}{2}$-in. gauge engine, or larger. At the same time they need something a little more hefty than a gauge "1" job—so what about it? Well, it is entirely a matter for your good selves, and our worthy friend who wields the blue pencil. During the whole time I have been writing these notes, it has been my policy to give readers what they want, *not* what I wanted to "push down their throats," in a manner of speaking. I have been guided by the huge correspondence, and endeavoured to give descriptions of types and sizes of locomotives asked for by the majority, working something in for the minority where an opportunity arose, so as to try to please as many readers as possible. The sole reason why I never described in full, how to build a locomotive with poppet-valve gear, *was simply because nobody wanted it*; I could describe either the rotary or oscillating cam type, just as simply as I can describe slide and piston valves with conventional gear. Incidentally, I hope to give, in the very near future, a brief illustrated description of how a poppet-valve gear operates, for the information of some readers who want to know "how it works." There are several small poppet-valve locomotives in existence—I gave an illustration and a short account of one, some years ago, in these notes; it was built by a reader in Lancashire—but as I can get greater efficiency from the ordinary valves and gear, I should never bother about building one myself.

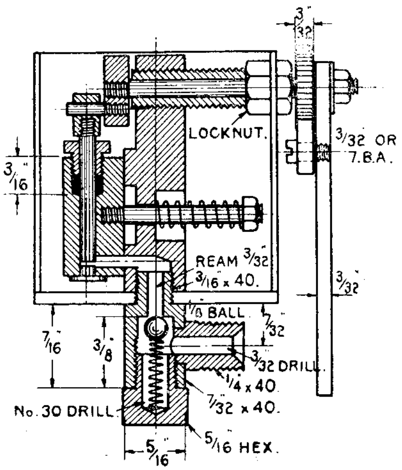
For the same reason, I have never fully described in this journal, how to build a turbine-driven locomotive, although in a contemporary, many years ago, I gave a short description of how to use a turbine designed by Mr. F. Geary, to drive a locomotive. Mr. Geary arranged his turbine to fit nicely into the body of a $2\frac{1}{2}$-in. gauge tender; so I arranged for a conventional type of locomotive boiler and chassis, and connected the turbine shaft to a worm drive on the rear coupled axle, by a piece of automobile speedometer cable. Several of the engines were built, more for experiment than anything else, as the power output was nothing like comparable to a similar engine with cylinders. As a matter of fact, I arranged matters so that the turbine could be removed, and cylinders fitted; and as far as I know, that is exactly what happened to the engines when the experimenters got tired of the turbine. My boiler supplied all the steam the turbine needed, but the engines had neither the power nor efficiency of the usual type. Before leaving the subject of unusual engines, I might mention that I had something in mind to amuse the kiddies next Christmas, viz. a "diesel" shunting engine operated by a hot-air motor. As the flame is entirely enclosed, and there is nothing to go off pop, any intelligent youngster could amuse himself—or herself; two small girls love to watch what they call my "dolly train" at work—in perfect safety, for just as long as they fancy. If I can manage to make the drawings, and the K.B.P. has no objection, I hope to include it. It is an exceedingly simple job.

Reverting to the $2\frac{1}{2}$-in. gauge engine, just say what you require; but for goodness sake, don't make it too complicated. We haven't much room to play about in, on this gauge; and as Nature can't be "scaled," working parts have to be made fairly substantial, to stand up to the racket of live passenger hauling. I would call the attention of new readers to the fact that I have already described plenty of $2\frac{1}{2}$-in. gauge jobs, and full sets of full-size blueprints are obtainable for these, both from our offices, and from our approved advertisers; the latter can do all that is needful, in the way of castings and material. Among the requests, were a few asking for something which would be a reminder of bygone days, yet powerful enough for the purpose. Well, what about perpetuating the old L.N.W.R. with a "19 in. goods," the mixed-traffic version of the 4-6-0 *Experiment* and *Prince of Wales* classes; they have inside cylinders and Joy valve gear. If an outside cylinder job is required, the Jones 4-6-0's of the Highland Railway would be a good subject to copy; or one of the old North Eastern 0-8-0 mighty haulers illustrated some time ago by Mr. Hambleton. For those who prefer something very simple, I might point out that *Tich* could be made to operate on $2\frac{1}{2}$-in. gauge, by the ultra-simple expedient of closing the frames in 1 in., and taking 1 in. off the axles. The only difference to the boiler would be that the firebox would need squeezing in a bit, to go between the frames; or as an alternative, a wide firebox could be fitted, extending over the narrowed-in frames. For a powerful six-coupled tank, the Reevesco *Gert* could be built to half size. Anyway, sing out what you want; I'll do my best, as heretofore.

Beginners' Corner (contd.). Oil Pump for "Tich"

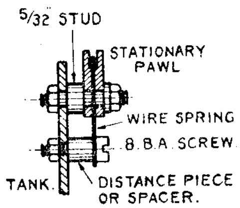
Having made the oil tank, we now need a pump to put inside it. Before "standardising" on this particular type of pump, I did a lot of experimenting, as usual, with several types of stationary-barrel pumps operated by slide cranks, eccentrics, and cams; but I found that for simplicity and absolute reliability, the oscillating-cylinder pump had the other kinds well and truly beaten. It will continue to operate, even with leaky clacks, the movement of the cylinder over the ports constituting, in effect, a mechanically-operated

valve. If the faces of cylinder and stand are true, it is impossible for steam and water to blow back into the lubricator, as the " entrance to the way out " is completely closed when the pump ram is not forcing oil through it. Beginners can see this plainly enough, by noting the action. When the cylinder inclines to the right, the port



Section of lubricator

in same, coincides with the left-hand port at the bottom of the stand, the right port being completely closed. The ram being then on its outward stroke, oil is sucked up into the pump barrel *via* the groove in the bottom of the stand. As the ram arrives at the top of the stroke, the upper part of the pump cylinder swings over to the left, the lower part moving to the right; and by the time the ram begins to descend, and force the oil out of the barrel, the port in the cylinder has moved over to cover the outlet port in the stand. The oil then goes through the port and the little duct behind it, into the clack box under the oil tank; forces down the clack ball, and proceeds along the oil pipe to the check valve under the steam tee. Here it repeats its " get-out-of-the-way " tactics on the check valve ball,

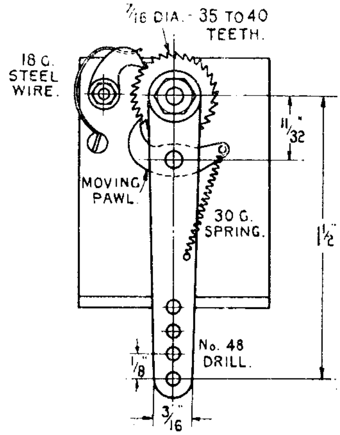


How to erect stationary pawl

and mingles with the steam entering the tee from above. The steam atomises it, and blows the particles along the cross pipes to the two steam chests, where the oily spray performs its allotted task of keeping the slide valves, pistons, and rods in first-class working trim. Well, now we proceed to do a bit of " watchmaking."

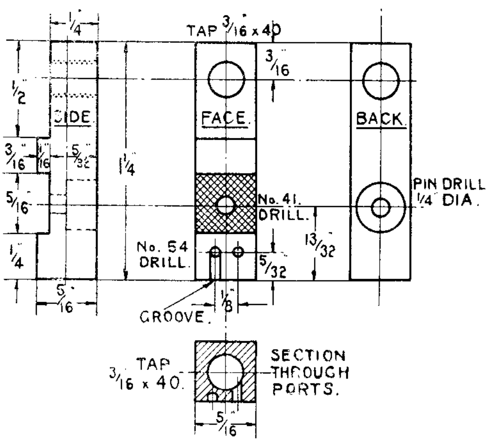
Pump Stand

The stand is made from $\frac{5}{16}$-in. square rod; bronze or gunmetal is naturally best, but brass will serve, if nothing better is available. As the pump spends all its working life practically drowned in oil, wear is negligible. Either chuck



Ratchet drive

the rod, and part off a $1\frac{1}{4}$ in. length, or saw to full length, chuck, and face both ends to correct length. One end must be set to run truly in the four-jaw; then centre, drill to 5/32 in. full depth with 5/32-in. or No. 22 drill, tap $\frac{3}{16}$ in. × 40, and skim off any burrs. At $\frac{3}{16}$ in. from the



Oil pump stand

opposite end, on the centre line of one of the facets, make a heavy centre-pop, and drill a 5/32-in. or No. 22 hole clean through. This job must be done either on a drilling-machine, or in the lathe as previously described, because the hole *must* go through dead square; same applies to the trunnion-pin hole next mentioned.

Tap the upper hole $\frac{3}{16}$ in. × 40, using a taper tap to start, so as to ensure a true thread.

Next, on the same centre-line, but 13/32 in. from the bottom of the stand, make another centre-pop and drill it No. 41. This must also be dead square. Then drill the ports; scribe a line across the face, 5/32 in. from the bottom, and make a centre-pop on it, at $\frac{1}{16}$ in. each side of the centre-line. Using a No. 54 drill, drill right through the right-hand pop-mark, into the tapped hole at the bottom of the stand; and be mighty careful as the drill breaks through into the hole, or you'll get a break of another kind—the sort of break, which if repeated too frequently, tends to make you go "broke." Drill the left-hand pop-mark to a depth of about $\frac{1}{16}$ in. only; and with a little chisel made from a bit of silver-steel, cut a groove from the port to the bottom of the stand, as shown in the illustrations.

The face of the stand has now to be rebated to $\frac{1}{16}$ in. depth for $\frac{1}{2}$ in. down from the top, and recessed $\frac{1}{16}$ in., to a width of $\frac{5}{16}$ in. across the trunnion-pin hole. This is just another job where a vertical slide comes in handy. If the stand is held horizontally in a small machine-vice, regular, or improvised with bits of angle as previously described, and attached to the slide, the stand can easily be moved up and down, past a $\frac{5}{16}$-in. end-mill, or home-made slot-drill, and the recess and rebate cut in two wags of a dog's tail. I make half-a-dozen stands at once, clamp them all together in a machine-vice on the table of my milling machine, and run the lot under a $\frac{5}{16}$-in. end-and-face cutter on the arbor. Anybody who has a small planing or shaping machine, can catch the stand horizontally in the machine-vice, and operate with a square-ended tool in the clapper box. Failing any method of machining, put the stand in the bench vice, with the business side projecting $\frac{1}{16}$ in. above the jaws (no need to bother about "mike" measurements!) and file away the recess and rebate until the file touches the vice jaws. Quit filing at the first scrape of the file on the steel, or you'll need a new file for the next job. Discretion saves file teeth! Finally, with a $\frac{1}{4}$-in. pin-drill having 3/32-in. pilot pin, form the circular recess shown in the illustrations, 5/32 in. deep, in the back of the stand. You'll know about pin-drilling, from experience of the leading bosses of the coupling-rods. Then true up the working face, exactly the same as described for slide valves and port faces. The stand is then complete.

Pump Cylinder

Cut a piece of $\frac{5}{16}$-in. square rod to a full $\frac{5}{8}$ in. length, as described above. Scribe a line across the middle of one end, and at $\frac{3}{16}$ in. from one end of it, make a centre-pop. Chuck in four-jaw with this mark running truly. Open it with a centre-drill, and drill clean through with No. 43 drill. Open out to $\frac{3}{16}$ in. depth with 5/32-in. or No. 22 drill, and tap $\frac{3}{16}$ in. × 40. Put a 3/32-in. parallel reamer through the rest of the hole. Home-made reamers do fine for jobs like these; file off the end of a bit of 3/32-in. round silver-steel on the slant, harden and temper to dark yellow, and rub the oval flat face on an oilstone. Reverse in chuck, and face off the other end; then turn a tiny plug, as shown, from $\frac{3}{16}$-in. brass rod, but before fitting it, drill the port and trunnion holes. Scribe a line down the rubbing face; that is, the one farthest away from the bore. Mark the two spots one 3/32 in. from bottom, and the other $\frac{1}{4}$ in. above it. Drill the first one with No. 54 drill, going right into the bore. Drill the other No. 48, but *don't* pierce the bore; tap it 3/32 in. or 7-B.A. instead, and in it fit a trunnion pin made from 3/32-in. round steel (silver or rustless) cut to length a of $\frac{13}{16}$ in. and screwed at both ends. Poke the 3/32-in. reamer through again, to cut away any burrs, and remove distortion; then drive the weeny plug in the bottom end, and solder it. Soft solder will do.

The gland is made from $\frac{1}{4}$-in. hexagon brass rod, the screwed part being $\frac{1}{8}$ in. long, and the head $\frac{1}{16}$ in.; as the process is exactly the same as for piston-rod and valve-spindle glands, I don't have to detail that bit out again; you use your experience! The pump ram, or plunger (it both plunges and rams!) is a piece of 3/32-in. round rod, $\frac{3}{4}$ in. long; rustless or ordinary steel, or hard-drawn bronze all do very well. Put a few threads on one end. The little big-end (says Pat) is made from a bit of $\frac{1}{8}$-in. brass, $\frac{3}{16}$ in. wide, filed to the shape shown, drilled and tapped in the thickness, to take the ram, and then cross-drilled No. 48 for the crankpin. The easiest way to do the job, is to screw the bit of brass on the end of the ram first; then go ahead and file to shape and drill as shown. Round off the sides of the cylinder, as shown in the plan view; temporarily remove the trunnion-pin, true up the rubbing-face, as described for slide-valves, etc., then replace the pin, assemble as shown, pack the gland with a few strands of graphited yarn, poke the trunnion-pin through the hole in the stand, fit a spring wound up from 22-gauge steel wire, and secure with a commercial nut and washer.

Crank and Bearing

To make the crank, chuck a piece of $\frac{3}{8}$-in. round brass rod; face the end, centre, drill down about $\frac{1}{4}$ in. with No. 48 drill, and tap 3/32 in. or 7-B.A. Part off a $\frac{1}{8}$-in. slice. At 7/64 in. from centre, drill a No. 53 hole, tap it 9-B.A., and screw in a crankpin made from 15-gauge spoke-wire, leaving $\frac{3}{16}$ in. projecting. The spindle is merely a piece of 3/32-in. round steel, $1\frac{5}{16}$ in. long, with $\frac{1}{8}$ in. of thread on each end, and is screwed into the crank disc.

For the bearing, chuck a piece of $\frac{5}{16}$-in. hexagon brass rod in the three-jaw; face the end, centre, and drill down about $\frac{7}{8}$ in. depth with No. 41 drill. Turn down $\frac{3}{4}$ in. of the outside, to $\frac{3}{16}$ in. diameter; screw $\frac{3}{16}$ in. × 40 with die in tailstock holder, part off to leave a head a full $\frac{1}{16}$ in. thick, reverse in chuck, skim the face, and chamfer the corners. The nut is just a $\frac{1}{8}$ in. slice of the same rod, drilled 5/32 in. or No. 22, and tapped $\frac{3}{16}$ in. × 40.

Check-valve or Clack

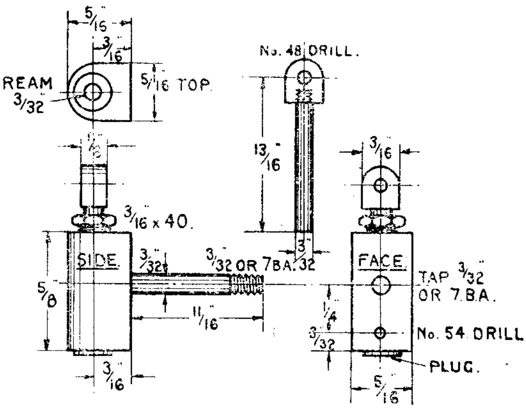
Chuck a piece of $\frac{5}{16}$-in. round rod in three-jaw; face the end, centre, and drill down about $\frac{3}{4}$ in. depth with No. 43 drill. Turn down $\frac{3}{16}$ in. of the outside, to $\frac{3}{16}$ in. diameter, and screw $\frac{3}{16}$ in. × 40. Part off at $\frac{7}{16}$ in. from shoulder. Reverse in chuck; open out with $\frac{3}{16}$-in. drill and D-bit to $\frac{3}{8}$ in. depth, slightly countersink the end, tap

7/32 in. × 40, and skim off any burr. Put a 3/32-in. parallel reamer through the remnants of the No. 43 hole. Drill a $\frac{3}{16}$-in. hole in the side; and in it, fit a $\frac{1}{4}$-in. union screw. Chuck a bit of $\frac{1}{4}$-in. round rod; face, and centre deeply with size E centre-drill. Drill down about $\frac{7}{16}$ in. depth with 3/32-in. or No. 42 drill. Screw the outside $\frac{1}{4}$ in. × 40 for $\frac{1}{4}$ in. down and part off at $\frac{3}{8}$ in. from the end. Reverse in chuck—you can grip by the threaded part, as long as the chuck jaws are not tightened sufficiently to cut the thread—turn down $\frac{1}{16}$ in. to a tight fit in the hole in the side of the clack body, squeeze it in, and silver-solder it. Pickle, wash, and clean up; seat a $\frac{1}{8}$-in. rustless ball on the small hole, same method as described for pump. Make a cap for the end, from $\frac{5}{16}$-in. hexagon rod, same process as for glands, but don't drill right through. Only go as far as the middle of the hexagon part Use No. 30 drill. Wind up a spring from thin steel wire, about 26-gauge, and assemble as shown in the section of the complete lubricator. The spring should just begin to compress, as the threads on the cap engage those in the clack body.

How to Erect the Pump in the Tank

Simple job, this! Put the stand in the middle of the tank, and screw the stem of the clack into it, through the hole in the base. Line up the hole in the top, with the hole in the side of the tank. Poke the end of the bearing through this, put on the lock-nut, and screw the end of the bearing into the top of the stand, until the head of the bearing just touches the side of the tank; don't force it, and distort the tank side. Run the lock-nut back, and tighten up; then tighten the clack. Note—in the sectional illustration, the clack is shown with the nipple, or union screw, pointing sideways toward the ratchet lever. It is shown this way, merely for illustrating the section. On the finished job, the clack, when tight, should have the union screw pointing to the back, as shown in the illustration giving a view of the complete pipe assembly in the last instalment of this "serial."

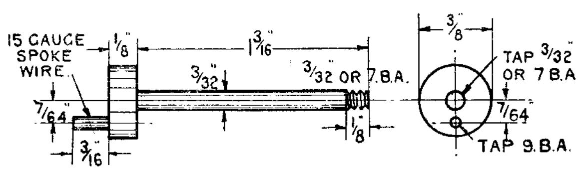
inside the tank, with the crankpin through the "big-end," push the spindle through the bearing, and screw it into the disc. When right home tight, there should be the weeniest bit of end play. Warning—be mighty careful to put the wheel on,



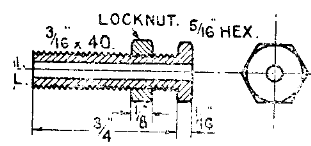
Oil pump cylinder

the same way as shown in the view of the ratchet-gear, viz. with the buttress (straight) side of the teeth to your left, at the top of the wheel, sloping away to your right, so that the wheel turns clockwise when operated by the pawls. The lubricator can now be tested by pouring some oil into the tank (ordinary motor engine oil will do) and turning the wheel. A distinct resistance should be felt, when the oil forces the clack-ball off its seating, on the downward stroke of the ram; and you'll find it impossible to stop oil coming out of the nipple, by putting your thumb over it (no matter if you have the strength of half-a-dozen folk of the Hercules type) when the wheel is turned. These lubricators have been tested against 400 lb. pressure, and that was nowhere near the limit.

The rest of the job is plain sailing. The ratchet



Crank and spindle



Crank spindle bearing

Ratchet Gear

Suitable ratchet wheels can be purchased from our approved advertisers. I could give instructions how to cut one on the lathe, but honestly, it isn't worth the trouble of setting up for the job; life's too short! It should be about $\frac{7}{16}$ in. diameter, with from 35 to 40 teeth. The hole in the middle will be small; open it out with a No. 43 drill, then press the end of the crank-spindle through, until same projects about 7/32 in. through. Check position from the actual job; hold the crank-disc opposite the end of the bearing

lever is nothing more formidable than a bit of $\frac{1}{4}$ in. × 3/32 in. strip steel filed to the shape shown. Drill the upper end No. 41, to take the crank spindle; at 11/32 in. below that, drill No. 48 and tap 3/32 in. or 7-B.A. for the pin carrying the moving pawl. About $\frac{3}{4}$ in. from the bottom, drill a $\frac{1}{16}$-in. hole close to the side of the lever, for the end of the pawl spring, and finally drill four No. 48 holes at the bottom, $\frac{1}{8}$ in. apart, to provide adjustment for the driving-fork.

Both pawls are filed up from 3/32-in. steel,

(*Continued on page* 879)

A 90-deg. Vee-Twin Flash Steam Plant

by George A. Nurthen

THIS marine plant was of the writer's own design and mainly built up from castings, in the case of the cylinders, crankcase and bearers. For instance, the crankcase was moulded from two melted-down pistons from 350-c.c. motor-cycle engines, which process did not produce a perfectly homogeneous casting, but gave a satisfactory result and was well worth the effort.

The Engine

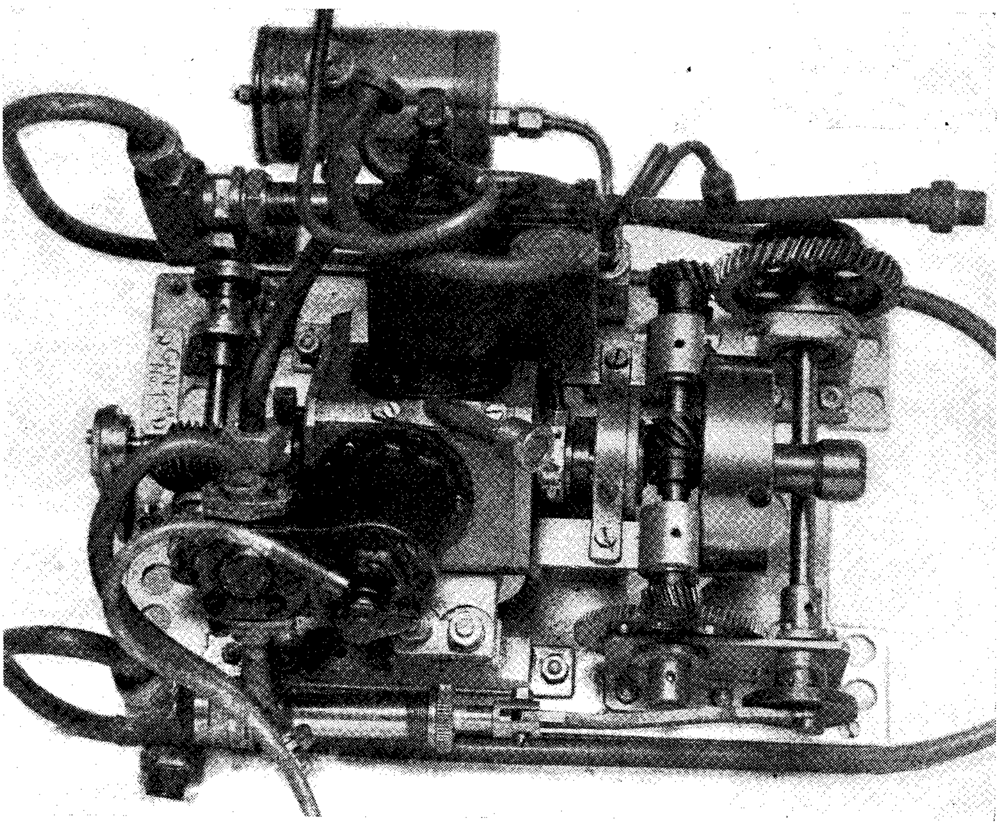
The cylinders were of close grained cast-iron (bore and stroke $\frac{3}{4}$ in.) with inside admission piston valves of stainless steel (diameter $\frac{7}{16}$ in.; stroke 9/32 in.). These valves and the "Meehanite" pistons were lapped to fit the bores to a very fine tolerance. Each of the two valves had two sets of exhaust ports, and the single-throw crankshaft, which ran on four ball-races, was built up and brazed, the crankpin being turned from nickel-chrome steel lapped after brazing.

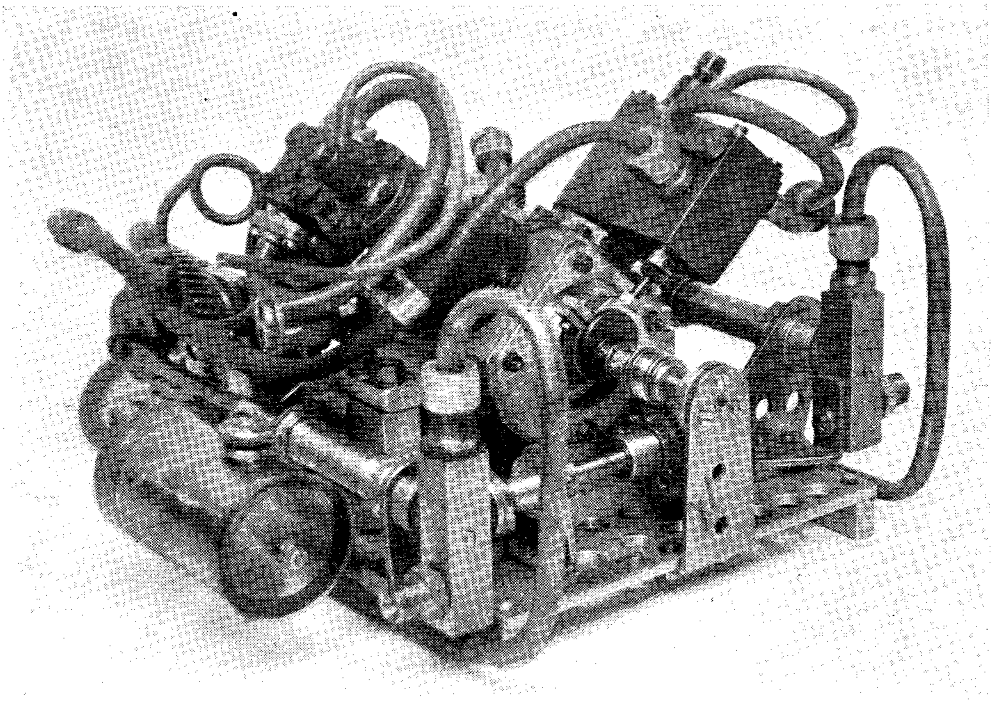
Duralumin connecting-rods, very light to reduce reciprocating weight, ran side by side, directly connecting to the crankpin. The writer has found that unbushed duralumin connecting-rods are highly efficient for high speed of any kind, and, in his opinion, there is no more satisfactory alternative to their adoption. To resume; each cylinder was fitted by means of spigots into the crankcase, and was each secured by five 6-B.A. studs. The forward cylinder was offset from centre line by $\frac{5}{16}$ in., thus enabling the connecting-rods to work side by side on the same crankpin.

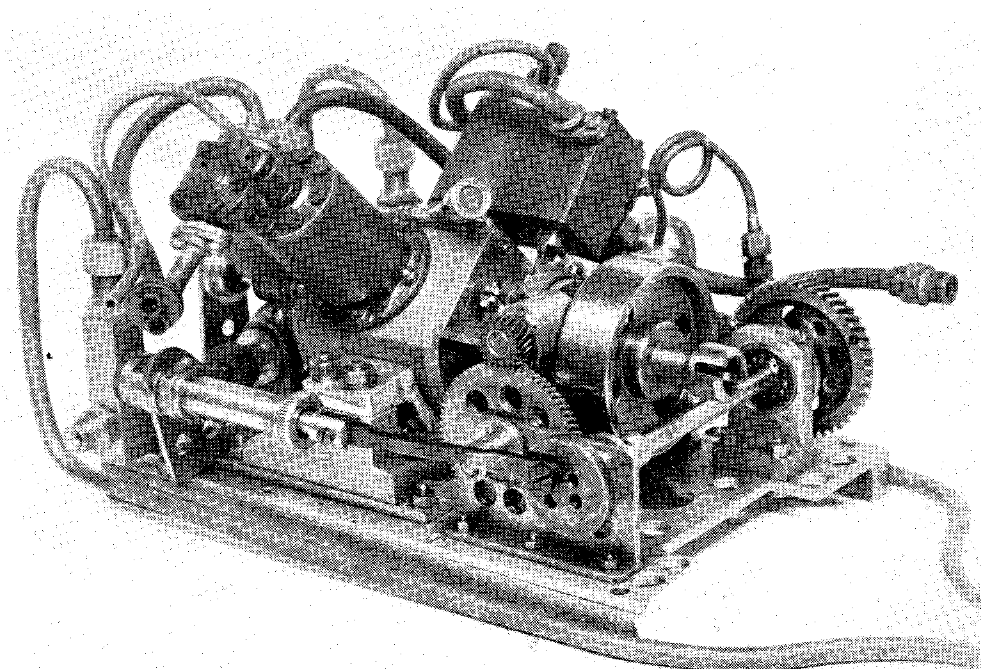
At either end of the crankcase were fitted the eccentrics, and to avoid excessive angularity of the valve rods, the cylinders were mounted so that the valve chests were in opposition.

The Gearing

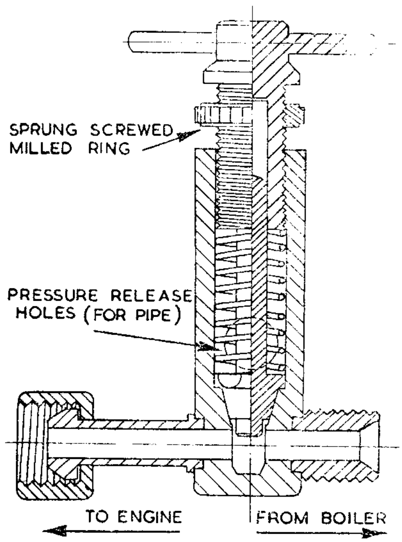
To start with, the crankshaft carried a 10-tooth hardened spiral gear, which meshed at 90 deg.







with an identical gear, which drove the cross-shaft. To the latter was fitted a 20-tooth helical pinion, which formed the first reduction stage of the feed-pump gearing. The cross-shaft, as described, formed an integral part of the engine, regarding the latter as a self-contained unit. Meshing with the cross-shaft pinion was a wheel of 24 teeth on the port side, driving on the



Section of the pressure release valve

opposite end a 15-tooth helical pinion meshing with a 45-tooth wheel, the whole arrangement giving a total reduction of 11 : 1 to the opposed stroke boiler feed-pumps.

Feed and Oil Pumps

The pumps mentioned above were of a ball-valve type, with ¼ in. bore and 11/32 in. stroke (variable), having a common by-pass fitted at the boiler connection. A perspex oil tank was fitted to the oil pump (⅛ in. bore, ⅛ in. variable stroke) which was driven at a reduction of 48 : 1 through worm and wheel. Each cylinder-head was fitted with a decompression valve which, when opened for starting, allowed condensate to be expelled and thus prevented hydraulic locking. At the engine boiler connection further efficiency was ensured with a pressure release valve of stainless steel, spring loaded, and capable of being pre-set to lift at varying pressure from 50 lb. to 200 lb. per sq. in. This also provided a means of stopping the engine quickly.

The Boiler

This consisted of 25 ft. of ¼ in. diameter tubing wound round into two coils, one above the other, the shorter inside coil acting as a superheater, and had a 2¼ in. diameter flue. Unfortunately, stainless steel tubing was not available when the plant was built, otherwise it would have been used. These coils reach dull red heat, and will eventually burn out, as recent examination has shown much flaking already. Stainless steel tubing is therefore regarded as essential, at least for the inner superheating coils.

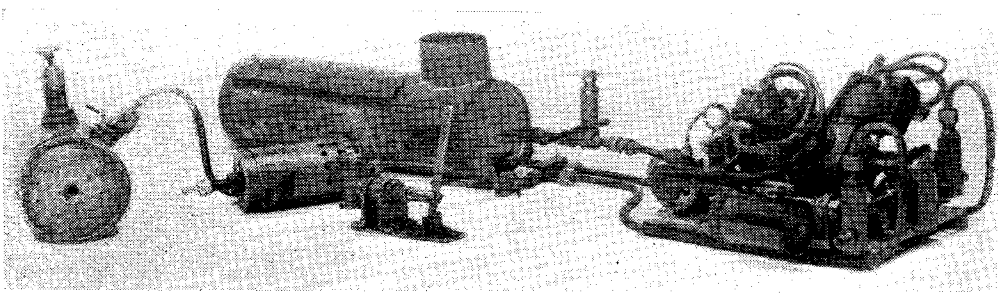
The Blowlamp

After a great deal of experiment, a most satisfactory blowlamp was evolved, giving a very intense flame with paraffin. It had an internally wound brass vaporising tube with four coils (1¼ in. interior and 1¾ in. exterior diameter) which fitted inside a tube of 1¾ in. diameter internally. The jet was 0.018 in. in diameter, and was made variable by means of a needle-valve which, when fully screwed home, acted as a pricker. It should be noted that the large fuel container shown connected to the burner was for bench use only.

Performance

For the first tests on the engine a twin drum water tube boiler was used to enable the engine to be gradually stepped up to varying determined pressures. This boiler was fed from its own pump, the engine's water pumps not being used in this case.

The engine, running light, was allowed to tick over at 20 lb. per sq. in. This was increased to 30 lb., and then, after half an hour, to 55 lb. The engine speed at this pressure was 6,048 r.p.m., determined by a rev.-counter fitted, at a reduction of 48 : 1, to the oil pump shaft. At 80 lb. the speed was 8,000 r.p.m., though this was held for only a few minutes, as it was found that the oil pump was supplying too much oil. This was



not surprising, considering that, so as to ensure an adequate supply, the pump stroke had been increased to $\frac{1}{4}$ in. After some effort a stroke of $\frac{1}{8}$ in. was set and this has proved to be sufficient.

Pressure was again raised, and for 15 minutes the engine was run at 80 lb. per sq. in. This proved a hectic procedure, as not only boiler level and gauge needed close attention, but also the engine, which, though stoutly clamped down, appeared to be about to take off at any moment. At this time, the engine was running perfectly well, emitting a deafening whine, and the results of the tests seemed satisfactory. It was only when about to call a halt to the whole procedure that smoke was noticed coming from the forward eccentric, which had assumed a blue coloration. On dismantling, it was found that the bronze sheave was embedded with steel particles, and that the eccentric had taken on the appearance of a ploughed field!

This setback, however, was soon rectified by reskimming the eccentric and reboring the sheave to suit; and a highly smoothed finish was given both surfaces to avoid further seizures. At this stage the engine was thoroughly examined, and the oil distribution to each cylinder left nothing to be desired. All parts were checked and no other faults were found.

The next stage was to use the flash boiler, and it was here that the trouble really started. Priming was rather a problem, and a great deal of fuel was used before any results were attained. The pumps required very delicate setting, and their consistency depended upon that of the blowlamp.

The pressure release and the decompression valves stood firm as a last line of defence, and so prevented any blowing of heads or bending of connecting-rods.

At each run the engine would reach tremendous speeds, almost screaming, although only for short bursts, as, when priming occurred, there would be coughing and spluttering before it picked up again. The remedy found for this was careful adjustment of the pump strokes, but a differently wound boiler would probably have made a difference. The superheater steam and high temperature rendered a pressure gauge inadvisable, but from the pre-set release valve a pressure of 150 lb. was indicated.

A damping brake with wood blocks was fitted to the flywheel for a load test. This, it is true, is a makeshift method, but it is effective, though the load applied cannot be readily calculated. Eventually a more stable $\frac{1}{4}$ h.p. electric motor was used, coupled to the flywheel dog. Running under this test the engine averaged 6,000 r.p.m., although this test was not without drawbacks as various motors of the same h.p. can differ considerably in their amounts of running friction. All the same, it is the writer's opinion that the loads applied were equivalent to any that the engine might have to cope with in practice.

"L.B.S.C."

(Continued from page 875)

to the shape shown in the drawing, and drilled No. 41 for the pins; the moving one has a $\frac{1}{16}$-in. hole in its tail, and the fixed one (woodpecker head) is slotted or grooved for a wire spring. If possible, make the pawls from gauge steel, same as recommended for expansion-links, and harden and temper them to dark yellow. If mild-steel is used, case-harden as previously described. The moving pawl is attached to the ratchet lever by a screw with 3/32 in. of "plain" under the head, as described for valve-gear. The stationary one is mounted on a stud, so as to bring it out level with the wheel; see cross-section shown in the small detail sketch. The stud is just a piece of 5/32-in. round steel rod $\frac{7}{16}$ in. long, turned down to 3/32 in. diameter for 7/32 in. length at one end, and screwed just sufficiently to take a nut; the other end is turned same diameter for $\frac{1}{8}$ in. length, and screwed likewise. The pawl is mounted on the longer end, and secured by a nut and washer; when the nut is tight, the pawl should still be free to move easily. The shorter end is pushed through a No. 41 hole drilled level with the crank-spindle, and about $\frac{1}{8}$ in. from the side of the tank; it is nutted inside as shown. I cribbed the spring arrangement from an alarm-clock that I bought for a few shillings when I first went to work on the railway; it is still going strong, and keeps good time! The spring is just a bit of 18-gauge steel wire, bent into a swan-neck with a loop at the end, and is secured to the tank by an 8-B.A. screw (or any near size) nutted inside the tank; a distance-piece, made from a bit of 5/32-in. brass rod, drilled and parted off to $\frac{1}{8}$ in. length, keeps the spring level with the pawl. The end rests in the groove, and keeps the pawl in contact with the teeth, preventing the wheel slipping backwards on the right-hand swing of the lever. The latter is placed on the end of the crank-spindle, and secured by a nut and washer; the nut should be tight at the end of the thread, whilst the lever is left free to swing. Before putting the lid on the lubricator, file a segment out of the flange directly above the end of the bearing, so that the lid can sit down on the box, and yet clear the hexagon head.

The complete lubricator is attached to the front buffer beam by two 6-B.A. screws; drill the No. 34 holes in the beam for same, at $\frac{13}{16}$ in. each side of centre, and 5/32 in. from the bottom edge of beam. Countersink them on the outside; then temporarily clamp the lubricator in place, and drill the holes in the lugs, using those in the frame as guides. Put two 6-B.A. countersunk screws in, and nut them behind the lugs. All being well, the drive will be illustrated in the next instalment.

Tale-piece!

Several correspondents have called my attention to a letter in the *Locomotive Express*, in which the writer claims that a spam can attained a speed of 140 miles per hour, and held it for four miles. Probably he read my Christmas ghost story; all I know is, that they would have had to call out the breakdown gang with brooms and dustpans, to sweep up the bits!

*AMATEUR FOUNDRY WORK

A Model Engineer's Record of Failures and Successes

by A. L. Headech

A CORE box is constructed from clean, straight-grained timber, its length coinciding exactly with the required length of the sum of the crankcase recess, and the projection of the core print. Note, there must be sufficient of the core beyond the crankcase recess, to prevent sand core overbalancing and falling into the mould. This cannot happen, of course, when the mould is closed. After the timber is planed to size it is cut into two pieces, and the position of the

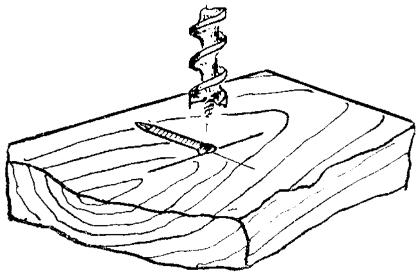


Fig. 28. *Boring hole for locating dowel in core box*

dowels marked. A common method here is to lay a veneer pin on one face of the half core box in such a position that the head lies on the required centre-line of the dowel hole. The other half is now placed on top and a scrap-piece of wood laid over all, and a blow given with a hammer or mallet. The pieces could be placed in a woodwork vice and pressure applied, as an

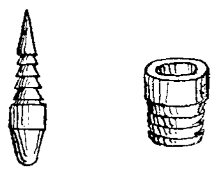


Fig. 30. *Patternmaker's brass dowels and sockets*

alternative method. On separation, the veneer pin will have made an indent, and the point of the brace bit is then inserted at the head end, Fig. 28. Beech dowel-rod will make quite serviceable dowels, but for those model engineers who wish to emulate the best work, brass dowels and sockets are obtainable. If more than one pair of dowels are located at a time, great difficulty will be found in getting them to line up correctly. This is due to the grain of the timber causing a slight wandering from the centre during boring operations. Another method of lining up the dowels is to mark the positions on one half and bore the two holes carefully through both faces. Now place the other piece against the former, inside faces together, and bore two blind holes. The dowel pins will fill the holes in the first piece and project from the face, for lining up the second, Fig. 29. The holes for brass dowels are best drilled, the one for the pin being a drill of mean core diameter size. This drill will do as a pilot, for the large hole required for the bush or socket portion. Great care should be used when driving these dowels in with a hammer to keep them upright for obvious reasons. Any

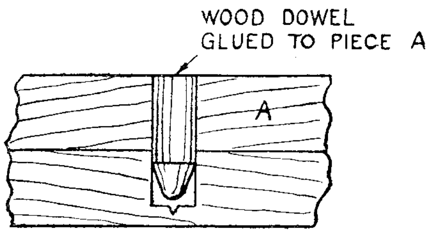


Fig. 29. *Parts of core box located by second method*

inaccuracy in alignment can often be put right by tapping the edges of the core box, or by filing the high spot on the dowel. The core box should not bind, but should fall away vertically under its own weight. Once the two halves are located they may be planed to exact dimensions overall, and then marked out for shaping the internal portions. This procedure always en-

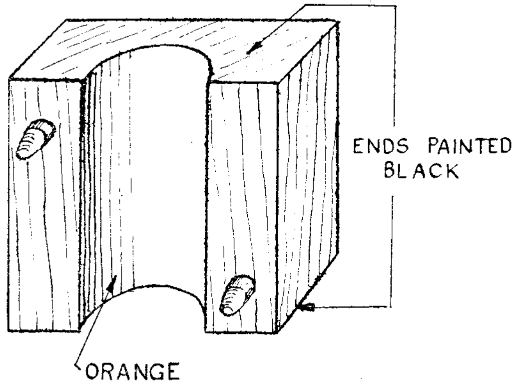


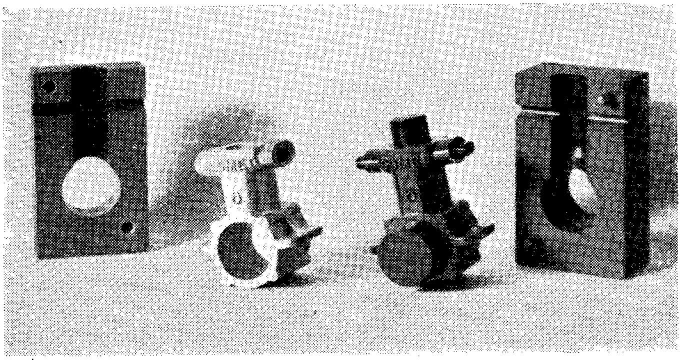
Fig. 31. *Half core box*

sures the halves of the core box lining up accurately afterwards, Figs. 30, 31, 31*a* and 31*b*.

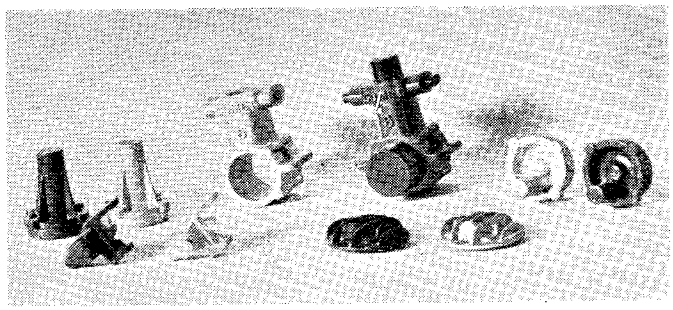
Making the Core

Cores are usually made from a sand which has a high silica content. As the sand has no clay binding material, it requires an artificial bond

Continued from page 817, "M.E.," June 8, 1950.



Left—Fig. 31*a*. *Core box, casting and pattern for a 6 c.c. engine designed by the author. Note core prints in pattern*



Below—Fig. 31*b*. *Patterns and castings for a 6 c.c. "Comet" engine*

such as linseed oil, resin, etc. Quite good results can be obtained with ordinary moulding sand made rather damper than usual. A flat board is necessary, in fact, the moulding board already mentioned will do very well. If the core is fairly robust, say 2 in. long and 1 in. diameter, no reinforcing wire is necessary. The sand can be rammed into the cavity from one end, the box being closed and standing upright on the board, during the operation. When the hole is filled and tamped down firmly with a trowel, a vent wire should be pushed right through the centre of the core sand. This vent will enable trapped gases inside the casting to get away into the surrounding moulding sand.

The box is tapped lightly to dislodge the core and the core box is slid over on to a metal tray or sheet. The two halves are gently taken away

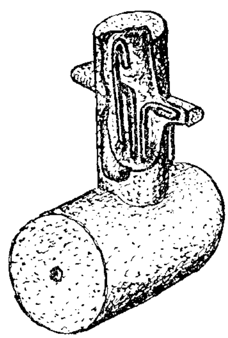


Fig. 35. *Drysand core broken away to show wire reinforcing*

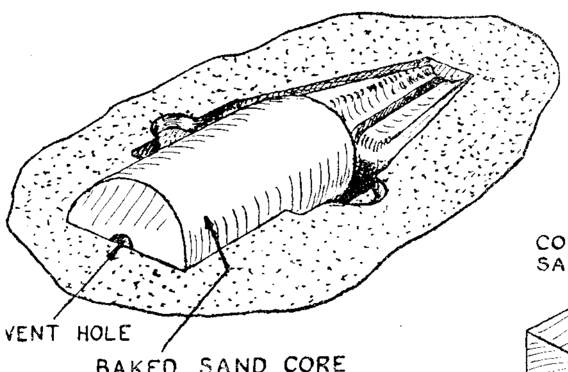


Fig. 32. *Drysand core in position in drag half of mould*

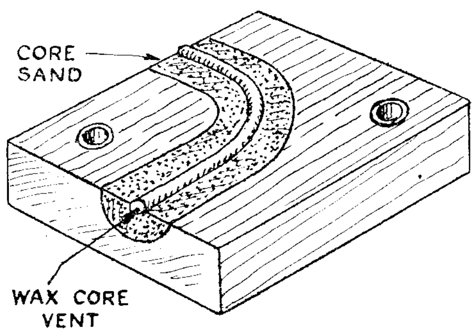


Fig. 34. *Half core box, showing use of core vent*

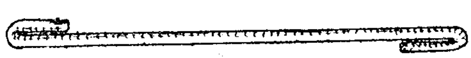
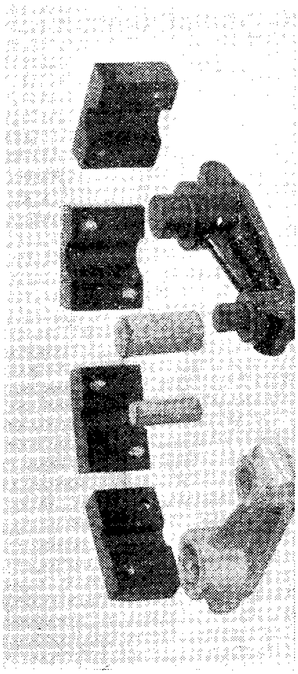
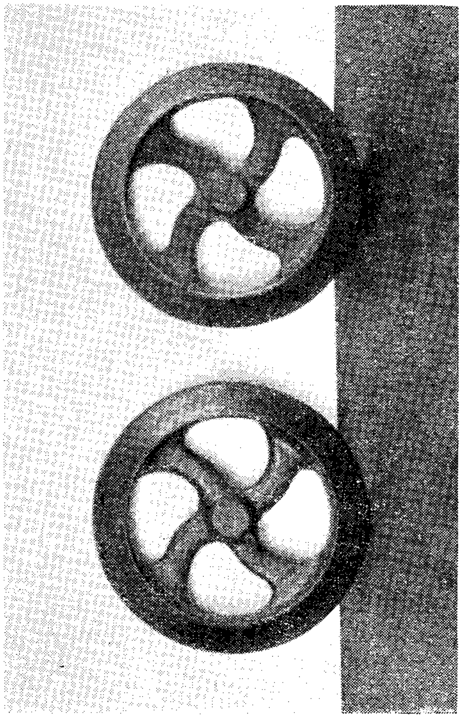


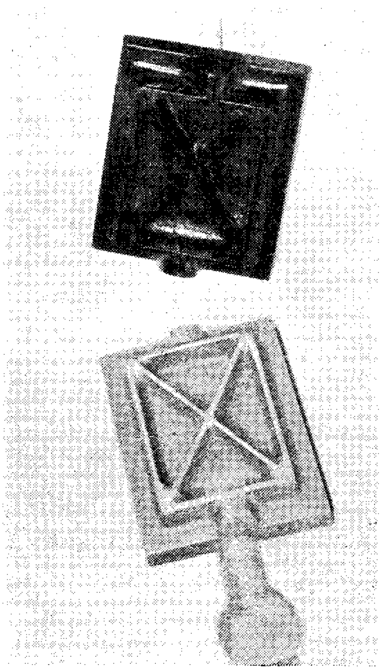
Fig. 33. *Wire rammer for core making*



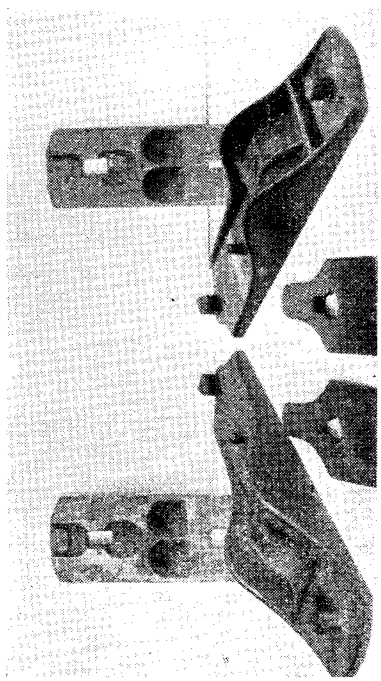
Pattern, cores, core boxes and castings for the "M.E." drilling machine. By kind permission of Mr. E. T. Westbury. (Boys' work)



Pattern and casting in bronze for bevel gear wheel. (Boys' work)



Casting and pattern for small surface plate (Boys' work)



Castings and patterns for smoothing plane, in bronze. (Boys' work)

from each side, leaving the core intact, standing on its end. Mix a creamy solution of plumbago and water, and paint this on to the surface of the core. After it is baked or dried with a gas flame, the plumbago will have left a firm, hard surface to the core sand. It will now be ready for insertion into the core depression made for it in the mould, Fig. 32. There are many examples casting. You will see from Fig. 35 how very necessary such support was, particularly for the exhaust passages. These would have broken at a touch, and certainly would not have survived their location in the mould.

A casting which is successful gives the model engineer a fitting reward for his application, patience and initiative. It may come at the end

Casting in bronze, 10 in. × 9 in., by the author. Photo by kind permission of the Surrey County Schools Amateur Boxing Association

Pattern for bronze shield (mahogany)

where this type of core can be used. Bores for cylinders, cored holes in bearing bosses, and anywhere that metal and machining time can be saved. Where drysand cores are of a slender character and have little strength of their own, they require supporting with soft iron wire. This wire is easily bent to suit various shapes of core, and should be about 16-gauge. When making a slender core, one half of the box is filled and the wire laid in the centre, the other half is then filled and the box closed. Ramming can now be done from the ends with a piece of wire which has a loop at the end, Fig. 33. These loops will push the sand gently and evenly into position around the reinforcing wire, thus producing a sound core. Air vents, of course, must still be added before removal for baking. Some cores are of such an intricate nature that it is impossible to push a vent wire in from one end and the venting must be accomplished by a different method. A wax preparation is made, known as core vent and is obtainable in various diameters to suit large and small work. This core vent is laid in the core sand of one half of the core box with ends flush with the open faces (Fig. 34), and the second half of the box filled and closed in the usual way. After removal the core is baked and as a result the wax melts into the surrounding sand, thus leaving the vent hole. A typical example of wire strengthening was used in a core for a model i.c. engine casting that I designed a few years ago. The photograph (Fig. 31*a*) shows the core box used and the

of a long series of failures, but the satisfaction obtained, I feel, far outweighs the bitter disappointment of the earlier stages. Try, try, again is the only motto in moulding, and is not peculiar to the amateur. I have been fortunate in obtaining help from professional moulders ; and even they admit their failures at times, to produce the perfect casting so enjoyed for its machining qualities by the model engineer.

I feel that I have only touched the fringe of this work in my article, but if I have given help and guidance to the disappointed triers, and a goal to the fearless adventurers who would like to say : " I made that model entirely myself." I shall feel that the labour has been worth while. The bronze shield illustrated was the outcome of months of hard work and bitter failures. The experience of the past years was not sufficient to bring success, and faulty castings persisted. I read what books were available on the subject, and finally found the information which led to success in a book on bronze work which was obtained for me by a municipal library. With this knowledge I tried again, and after twelve more attempts I succeeded in casting the four plaques required. A fifth hangs in my workshop, having just two letters defective, as a permanent reminder of that hard-won reward.

Correction. A spelling error has been noticed on page 734 of the May 25th issue. The word " tightly " in the fourth line from the bottom of the second column should read " lightly."

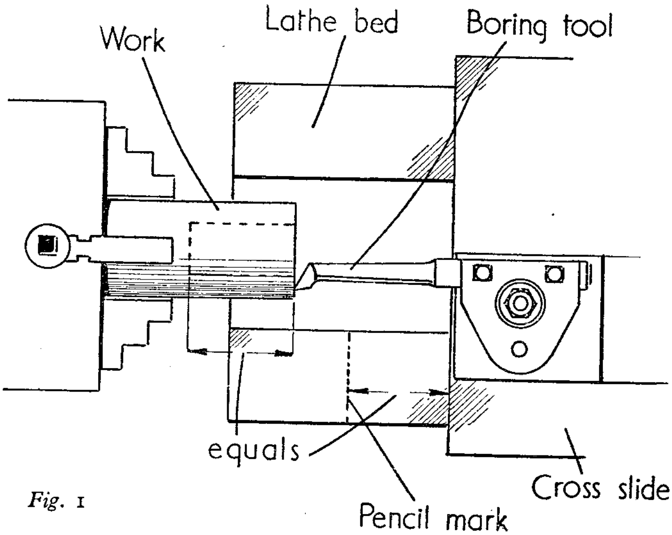


Fig. 1

Novices' Corner

Boring Blind Holes

THE novice will find that the boring of blind holes is a piece of lathework he will very often have to carry out, but it has been noticed that many workers are nervous about this operation.

The only difference between boring a blind hole and one that runs clear through lies in the need for determining exactly when the tool has reached, or very nearly reached, the bottom of the hole; for if the tool is forced by the feed gear against the blind end of the hole, damage may be caused either to the work or to the tool itself.

The simplest way of indicating that the tool has reached the end of its prescribed travel is to mark this point by a line drawn on the lathe bed either with a piece of chalk or with a grease pencil as shown in Fig. 1.

The position of this line is determined by bringing the point of the tool into contact with the end of the work, and then using a ruler to set off along the bed a distance equal to the depth of the hole.

Another method of ensuring that the hole is bored approximately to the correct depth is to make a chalk mark on the shank of the tool itself; a rule is then used to set the distance of the mark from the tool's point equal to the required depth.

Where greater accuracy is needed, a collar or a washer may be slipped on to the shaft of the tool to act as a depthing stop. This collar then bears on the face of the toolpost and the tool is fed forwards by hand until the collar comes into contact with the end of the work. The depth of entry of the tool into the work is determined by setting the tool with a rule to project for the correct distance from the collar.

Although the automatic feed can here be employed to bore the work nearly to the full depth, it is essential for the final exact depthing cut that the hand feed be used; otherwise, serious damage may be caused by jamming the lathe toolpost against the work.

The usual method of machining the hole is first to drill from the tailstock a $\frac{1}{8}$-in. pilot hole to the full depth of the finished bore; the pilot drill is then followed by a larger drill to open out the hole nearly to finished size, thus leaving but little material for the boring tool to remove.

It is usually advisable to use a succession of drills of gradually increasing size, rather than to attempt drilling to the full diameter at a single operation. Care must be taken to avoid drilling beyond the required depth, but usually the extra resistance encountered in the tailstock feed will indicate when the bottom of the pilot hole has been reached.

As it is not usually practicable in a small lathe to drill holes larger than $\frac{1}{2}$ in. diameter, any above this size must be formed with a boring tool.

Fig. 2 shows a hole in section drilled to the full depth and ready for boring to size; the outline of the finished bore is indicated by the dotted lines. As the bottom of the drill hole is of conical form it will be clear that the boring tool will have an increasing thickness of material to remove towards the end of its travel. For this reason, the automatic traverse gear of the lathe must be disengaged before the boring tool reaches this point, and the feed is continued by hand until the edge of the saddle coincides with the pencil line on the lathe bed, or until the tool has reached its full depth as indicated in the other machining methods described.

As previously mentioned, hand-feeding in the final stage of the machining may serve to prevent jamming and, in addition, this will keep the tool from digging into the work. In Fig. 3 is shown a form of tool that will be found to cut freely when boring either brass or steel. If the bottom of the hole requires only rough finishing, the tool may be set above centre, and with top rake, as shown in Fig. 4A. One useful form of boring tool has a round shank which is

clamped in a square holder for mounting in the lathe toolpost ; this method of construction allows the tool to be rotated in its holder in order to adjust the amount of top rake.

If the bottom of the bore is to be faced, the boring tool must be set on the lathe centre-line

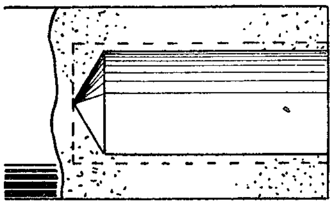


Fig. 2

as seen in Fig. 4B. The height of the tool may be checked either by reference to the headstock conical centre, or by means of the surface gauge when set to either of the lathe centres.

It is usual to relieve the bottom of a blind hole, forming a shaft bearing, in the manner shown in Fig. 5. This ensures that the shaft will run clear and without any tendency to bind. A tool used for this purpose has the cutting portion shaped like a parting-tool as illustrated in Fig. 6. The machining is carried out by first bringing the tool into contact with the bottom of the bore, and next, with the lathe running, the tool is set outwards until it begins to cut : the recess can then be machined to the required depth by reference to the cross-slide index. An undercut of 0.005 in. is sufficient to provide clearance for a shaft, and, in addition, this will form a small oil reservoir.

A positive method of ensuring that the point of the tool does not dig into the bottom of the bore is to provide some simple form of stop

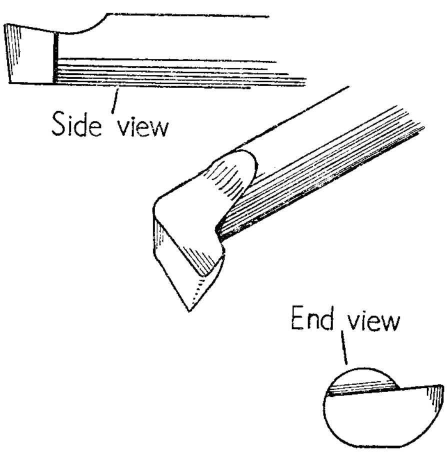


Fig. 3

which will limit the travel of the saddle. This may take the form of a piece of rectangular metal temporarily clamped to the surface of the lathe bed by means of a single bolt or clamping plate passing between the shears of the bed in the same way as the hand-turning rest is secured. A

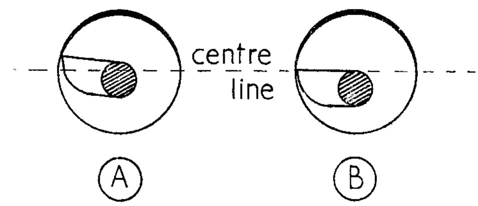


Fig. 4

more elaborate form of stop is illustrated in Fig. 7 ; this has the advantage that it can be adjusted to any exact setting and, moreover, its action will not be upset by chips accumulated on the lathe bed.

As will be seen in the drawings, the body of the device is made from a piece of rectangular mild steel. A brass-tipped clamping screw is provided to allow the body to be secured to the lathe bed, and the stop screw itself is fitted with a locknut to prevent any movement once the stop has been set. The brass pad fitted to the clamping screw is

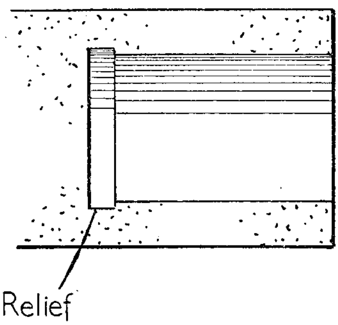


Fig. 5

of importance, as it prevents possible damage to the inner guide face of the lathe shear.

The more experienced lathe users will have noticed that, so far, reference has been made only to the use of chalk marks and the rule for setting the depth of boring. These methods, of course, can hardly be expected to give more than approximate results, which, however, may be all that is needed for ordinary work. Where greater accuracy is required, the lathe leadscrew, with its index graduated in thousandths of an

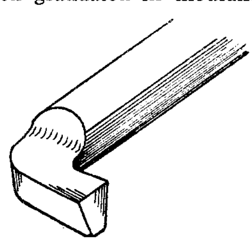


Fig. 6

inch, may well be used in the following manner :

The leadscrew clasp nut is closed and the leadscrew turned to bring its index to the zero position. The tool is then brought into contact with the work by advancing the top slide. All subsequent traversing of the tool is now carried

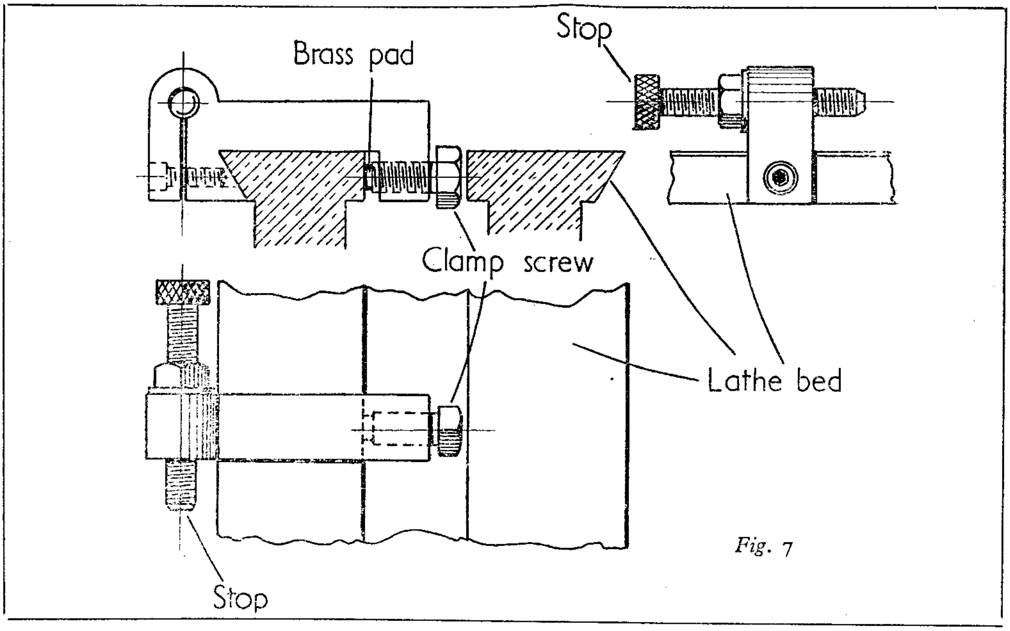


Fig. 7

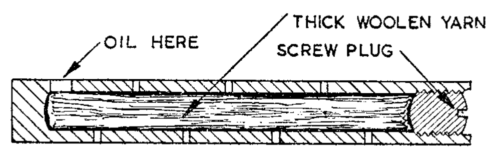
out solely by means of the leadscrew. It will be clear that the depth of boring can, in this way, be determined in inches and fractions of an inch by counting the number of turns made by the leadscrew and, at the same time, the exact depth, measured in thousandths of an inch, will be registered on the leadscrew index.

As mistakes are apt to arise when counting the turns made by the leadscrew, the advance of the tool should be checked with a rule when boring deep holes. However, this process will be simplified, even further, if a scale is attached to the lathe bed to give a direct measurement of the forward movement of the saddle. A device which serves this purpose well and is a most useful adjunct to the lathe was recently described by a contributor in THE MODEL ENGINEER under the title " Fitting a Saddle Index to the Lathe."

Wool Packed Spindles

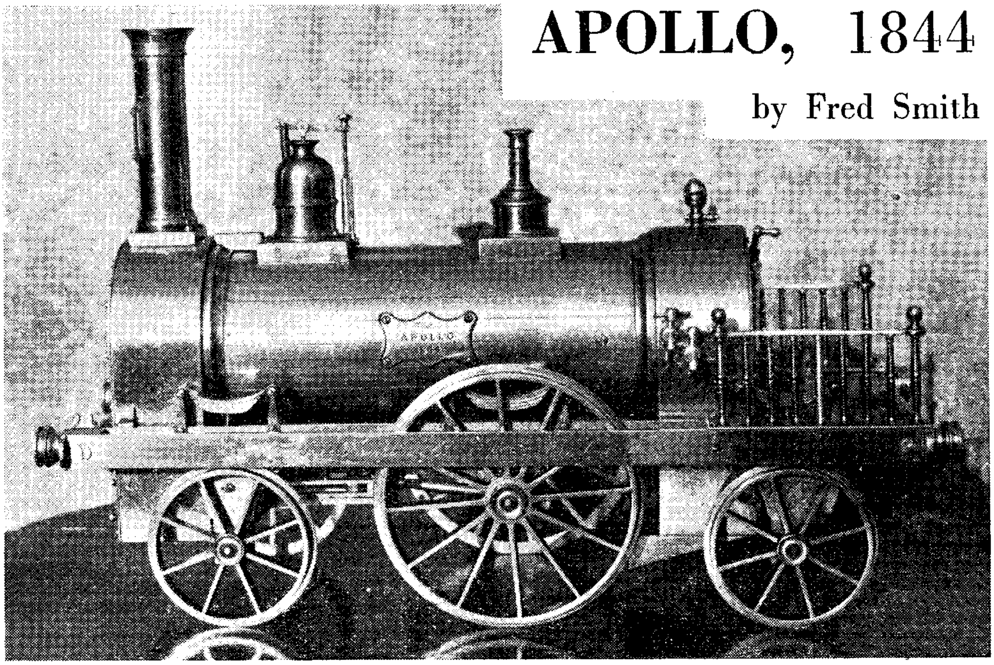
by F. Massey

THE manufacturers of industrial sewing machines have paid very close attention to the lubrication of the multiplicity of moving parts in the mechanisms. These parts are often very small and fitted to " tenths," and the maintenance of oil films between the metal surfaces is of the utmost importance.



While ball- and needle-bearings are gradually being introduced, the older types of machines almost exclusively used hardened and ground steel spindles running in cast-iron bushes, and this method has stood the test of time for high-speed rotating mainshafts and various applications where the motions are reciprocating and sliding. Machines which have been in almost daily use for industrial production for fifty years are often to be seen with the original shafts and bearings in excellent condition. Obviously their lubrication has been right, and the method of using drilled shafts with lengths of woollen yarn drawn through them might well be considered by our model engineering and toolmaking fraternity. Small holes—about 1/32 in. allow the oil to gain access to the working surfaces, and the oil supply to the woollen packing is replenished through a larger hole, either axial or transverse, at the end of the spindle.

As examples of this application, the jockey pulleys on the " M.E." type of drilling machine and the loose pulleys on the driving shaft may be so lubricated, and it will be found that small quantities of oil will last for a long time. Above all, the method has the advantage of extreme simplicity. How about model locomotive parts?



APOLLO, 1844

by Fred Smith

THE photograph on this page is of a very old locomotive which my son picked up a few years ago in a rather dilapidated condition in a junk shop in Nottingham. It was made by Franklin & Co., Manchester, and bears a nameplate "Apollo, 1844."

Judging by the fine workmanship and finish, it is the work of an instrument maker of the highest order and must have cost a considerable amount of money. Except for the crankshaft, axles and connecting-rods, it is all cut out of plate-brass, no castings having been used. It has a plain cylindrical boiler with one flue-tube through the lower half; a smokebox at the front end and dry type firebox at the driver's end. The two cylinders are at the bottom of the smokebox and have overhead slide-valves, the cylinders being horizontal and in line with the crank axle. The valves are worked through rocker arms, each driven by separate single eccentrics. The engine is non-reversing, as the eccentrics are keyed solid to the axle. An extension of the valve rocker-shaft carries an extra arm at each side, which transmits motion back to two imitation gab-gear handles on the driver's platform and are very realistic when the engine is working. The engine motion is fitted with adjustable brasses, gibs and cotters and double pattern slide bars. The main frames are double sided, cut out of $\frac{1}{8}$-in. brass plate. The steam dome is fitted with a Salter pattern spring safety-valve. A regulator in the smokebox is operated by the usual pattern handle driven through a tube in the top of the boiler. All the screws appear to have been hand-made with the Lancashire tapping plate and of no particular thread, and as many were loose or stripped, I re-tapped all the holes and made new ones to the nearest B.A. sizes, keeping the screw heads as near to the original sizes as possible. When I got the engine the steam chests, valves and spindles and steam exhaust pipes were missing. The hand rails were loose and several of the fencing pillars missing. Parts of the safety valve were broken and there were two cracks in the side frames. All these I have remade or repaired, as well as the high and low water test taps and front cylinder oil cocks. The engine is now in its original condition as far as I can estimate. Since the photograph was taken I have made a short length of old pattern track with fish bellied rails on stone blocks, mounted on a polished oak base. I set the slide valves and tested it at 10 lb. per sq. in. and it now runs perfectly.

Owing to the highly polished and lacquered boiler, I do not intend to spoil its appearance by running it under steam.

The leading dimensions are :—

Gauge of rails	$4\frac{1}{2}$	in.
Length over frames	$13\frac{3}{8}$	,,
,, ,, buffers	$14\frac{1}{2}$	,,
Width ,, frames	$5\frac{1}{8}$	,,
Length of boiler barrel	7	,,
Diameter of boiler barrel	$2\frac{7}{8}$	,,
From rail to buffer centre	$2\frac{7}{8}$	,,
,, ,, ,, centre-line of boiler	$3\frac{3}{4}$	,,
,, ,, ,, top of chimney	$9\frac{1}{2}$	,,
Diameter of driving wheels	4	,,
,, ,, leading and trailing wheels	$2\frac{1}{2}$	,,
Cylinder bore	$\frac{5}{8} \times 1\frac{1}{8}$	in. stroke
Weight of engine empty	10	lb.

I believe the engine represents the type used on the early North Midland Railway between Derby and Chesterfield.

PRACTICAL LETTERS

"Well I'm Blowed"

DEAR SIR,—I was in Penzance of Friday, May 5th, awaiting the night train to Paddington. Having an hour or two hanging heavily, I strolled casually along the jetty near the railway station, became interested in huge piles of "junk," amongst it all, a partly dismantled traction engine. Thought I, "what a pity I haven't a camera, this would interest 'M.E.' readers." Quizzed all over the machine—almost tearfully!

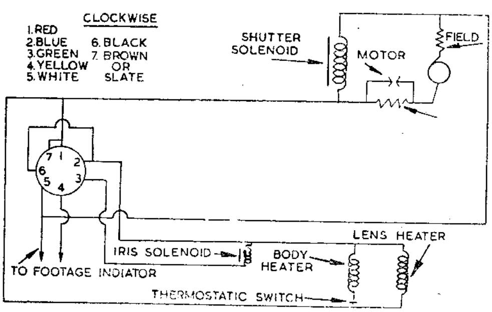
On arrival home next mid-day, I opened my son's copy of THE MODEL ENGINEER, and the first thing I spotted was a photograph of the self-same engine!—less than 24 hours after I had been standing looking at it on the quayside at Penzance!—Well, I'm blowed!

Yours faithfully,
Brightlingsea. EDGAR HARRISON.

Converting a Camera Gun

DEAR SIR,—Referring to your reader's query No. 9799, of April 27th issue, I was in a like quandary about the Camera Gun G45. It is difficult to adapt this as a cine camera unless one knows its method of functioning, so perhaps my experience will be of some use to the querist.

There are two types of these cameras, the 12 volt and the 24 volt models, but my remarks refer to the 12 volt model as supplied by Aero Spares.



First, let us call the top red pin No. 1, the next blue No. 2, next green No. 3, yellow No. 4, white No. 5, black No. 6, brown or slate No. 7. All counting clockwise.

Of these I ignored No. 2 blue, and No. 6 black, this latter being only a heater connection. One side of the battery was connected to No. 1 red, and No. 7 brown or slate. The other side was joined to No. 5 through a switch.

Switching on, causes the motor to start, and simultaneously releases the ratchet holding the the shutter. So long as the current is switched on, the ratchet is held up by its solenoid and the camera shutter revolves, giving its normal exposure of about 1/64th second.

If the weather is very sunny a switch should connect No. 1 red, with No. 3 green. This operates the iris magnet and causes the auxiliary blade of the shutter to lag, giving an exposure of about 1/214th second.

Since making these adjustments I have come across another diagram of connections which differ slightly from those in my camera. I append this diagram herewith in case it is of the type referred to by L.E. Even with these connections he can see that the essential thing is to switch on the motor and shutter coil together. The iris coil must have a separate switch for sunny days, and he can remove the heaters altogether.

In conclusion, I might add that I have made a dural box to fit to the bottom of the camera. This contains six U11 batteries with a press switch at the front end.

Yours faithfully,
Whitley Bay. JAMES MIDDLEMASS.

Stationary Steam Engines

DEAR SIR,—After reading Mr. Lane's letter in THE MODEL ENGINEER, of May 18th, suggesting a corner for stationary steam engines, I should like to add my approval of this suggestion. There must be many like myself with "scullery table" workshops, who would like a weekly "words and music" *à la* "L.B.S.C." to build a horizontal engine and boiler, like the ones described in THE MODEL ENGINEER years ago. I mean a simple, yet engineering, job with a built-up cylinder which could be made by those who like myself have a drilling machine, a few files and taps, a box of scrap but no lathe. I seem to remember how engines were made that "went," their cylinders made up from brass tube, the steam chests and valve faces "sweated" on. Crude they were, by modern standards, but many happy hours were passed in their making. Perhaps you could revive that pretty little overtype by Mr. Budd, published in THE MODEL ENGINEER, in 1912. What an ideal model engine she would make, with one of "Curley's" small coal-fired locomotive boilers.

Yours faithfully,
W. Kensington. C. J. B. BOVEY.

Model Submarine

DEAR SIR,—Regarding the enquiry No. 9789 on model submarines in the April 13th, 1950, issue of THE MODEL ENGINEER.

I have made several model submarines and here is how to make them dive and surface again automatically.

Provide a ballast tank big enough to give the model some negative bouyancy when the tank floods, that is, a few ounces tendency to sink when flooded. Provide a vent on top, spring-loaded. Leave free-flooding holes in the very bottom of the tank, always open.

Jam open the vent with a bit—a chip—of an alka seltzer tablet sold at druggists. This foams heavily when wetted. Load a couple of these tablets in the ballast tank itself through a screw hatch. Then sail the model, motor running.

She will run out say 15 ft. or so, flood, sink, go out of sight. The chip under the spring-loaded vent will soon dissolve and the vent will snap shut. The big tablets continue to foam, and expel the ballast out of the bottom holes the way it came in. The submarine will run another 10 or 15 ft. under water and then reappear on the surface, and continue blowing her tanks till they are empty and then she will be all blown, riding high, and continuing her way on the surface under motor propulsion.

I have an article in preparation on my system, which I originated myself, for THE MODEL ENGINEER. I have a 26-in. U-Boat, type VII-C, and I need just a few photographs of her to complete the material. Meantime your querist could try the system on his model.—It works.

I am always searching for submarine data, and drawings.

Yours faithfully,
Connecticut. L. S. McCREADY,
Commander, U.S.M.S.

The Goyen Lathe

DEAR SIR,—I was interested in the letter by Mr. Frazer on the Goyen lathe, and I am also interested in horology.

I am a proud possessor of a Goyen lathe with all equipment excepting the rose cutting frame.

The lathe I own was made for Mr. Singer, of sewing machine fame, the cost of the lathe I was given to understand was £1,150.

I was also pleased to read in the issue of April 27th the reply by Mr. Tweddle and Mr. Hindes and I certainly agree to the superb workmanship. I should think the one I have was one of the last lathes he made.

I have done a fair amount of ornamental and engine turning and find the using of the whole equipment most fascinating and interesting.

I consider these lathes inspire one to do finer work.

Yours faithfully,
Marldon. CHAS. H. HARVEY.

CLUB ANNOUNCEMENTS

Society of Model and Experimental Engineers

Will members who will be willing to serve as stewards on the society's stand and as helpers with the passenger-carrying track at the "M.E." Exhibition—August 9th-19th—please advise the hon. secretary as early as possible.

Hon. Secretary: A. B. STORRAR, 67, Station Road, West Wickham.

Bolton and District Society of Model Engineers

The May meeting held on May 9th was well attended. The lecture on "The Manufacture and Maintenance of Electric Accumulators" was very interesting and quite an amount of tips were obtained for their proper usage, special mention being made of charging rates and specific gravity of acid used.

The June meeting on June 13th at 7.30 p.m., in the Co-operative Rooms, Bridge Street, Bolton, Lancs., will have as its highlight a lecture by Mr. C. W. Page, A.R.I.C., on the "Manufacture and Uses of Synthetic Sapphires." This lecture will be of great interest, as little is known by the lay public of the way that natural stones are now reproduced commercially.

The "Opening Meeting" held at Leverhulme Park on May 21st, although held in indifferent weather was well attended. The model racing car fans had their fill. Mr. F. G. Buck, Meteor M.R.C.C., clocked 102.2 m.p.h. in the 10 c.c. British event, and his McCoy-powered car clocked 111 m.p.h. in the 10 c.c. open event. Mr. J. Clayton, Bolton S.M.E., returned 68.15 m.p.h. in the 5 c.c. class with his Eta-powered car. In the 2.5 c.c. class Mr. J. R. Parker, of the Meteor M.R.C.C., clocked 48.9 m.p.h. with his E.D.-powered car. These times are excellent considering the gusty winds and the wet condition of the track. The model locomotives were well represented—some running almost non-stop from 11 a.m. till 7 p.m. giving rides to the countless number of children that appeared every time the rain stopped. The Bolton society are greatly indebted to the societies that attended, for their support of this event.

The society extend an invitation to anyone with a model car or locomotive to use the tracks at Leverhulme Park—a line dropped to the address below will ensure that necessary supplies, etc., are laid on.

Hon. Secretary: NORMAN BROOKS, 12, Cleveleys Avenue, Bolton, Lancs.

Cambridge and District Model Engineering Society

The above society continues to increase in membership and activities. Owing to limited use of educational workshops it has been necessary to lease premises for accommodating members. Work is now in progress in making these available and the opening date will shortly be arranged.

The outdoor track, approximately 300 yds. round, is near completion. Membership of society is now sectionalised, with chairmen and committees for live steam, workshops, "OO" gauge, marine, etc., with co-opted representatives on the general committee. This has proved invaluable to an active society and results have benefited, as each individual has a committee to look after his particular hobby.

The programme for the remainder of the year has been set up which includes visits to the Cambridge University engineering laboratories, British Railways Locomotive Works, Cambridge, together with talks and films. Any model maker visiting Cambridge will be welcomed by the members at any meetings which are being held.

Hon. Secretary: J. W. ATKIN, 16, Ross Street, Mill Road, Cambridge.

Glasgow Society of Model Engineers

The position on the track is that the master rail is now laid all round the 760 yd. road. The task of welding the other rails, quarter jigs, and a portable welding plant is progressing well. On a recent Sunday some 232 welds were made.

Visitors will be welcomed at the site in Rutherglen. Particulars of membership can be had from the address below.

Secretary: JOHN W. SMITH, 785, Dumbarton Road, Glasgow, W.1.

Crewe Model Engineering Society

The above society are holding their third model engineering exhibition in the Corn Exchange, Crewe, on Friday and Saturday (2 p.m. to 10 p.m.; 10 a.m. to 9 p.m.), September 15th-16th, 1950.

A multi-gauge track will be in operation, also a "OO" gauge layout, 10 ft. square, and the other usual working models.

Hon. Secretary: A. BENNETT, 21, Hallshaw Avenue, Crewe.

Aylesbury and District Society of Model Engineers

At the last meeting, held on the third Wednesday of the month at the society's meeting place, Temple Square, Aylesbury, a full gathering was addressed by Mr. E. T. Westbury, who gave an interesting talk on the use of small lathe attachments, shedding much light on the subject of "setting-up," and lathe work in general.

This proved to be a subject of universal interest, as was shown by the members' questions afterwards.

Hon. Secretary: N. F. SOUTHERTON, Astracot, Buckland Wharf, Aston Clinton, Bucks.

Ickenham and District Society of Model Engineers

At the last meeting the chairman, Mr. Sales, gave a very interesting talk on his personal experiences in the realm of model engineering. Some interesting samples of his work were on show, and his talk must have been very heartening to the beginners. He stressed the help that could always be found in THE MODEL ENGINEER, and in discussion at society meetings.

Enquiries concerning future meetings should be addressed to the Hon. Secretary, A. F. DUNN, 27, Ivyhouse Road, Ickenham, Uxbridge. Tel.: Ruislip 3518.